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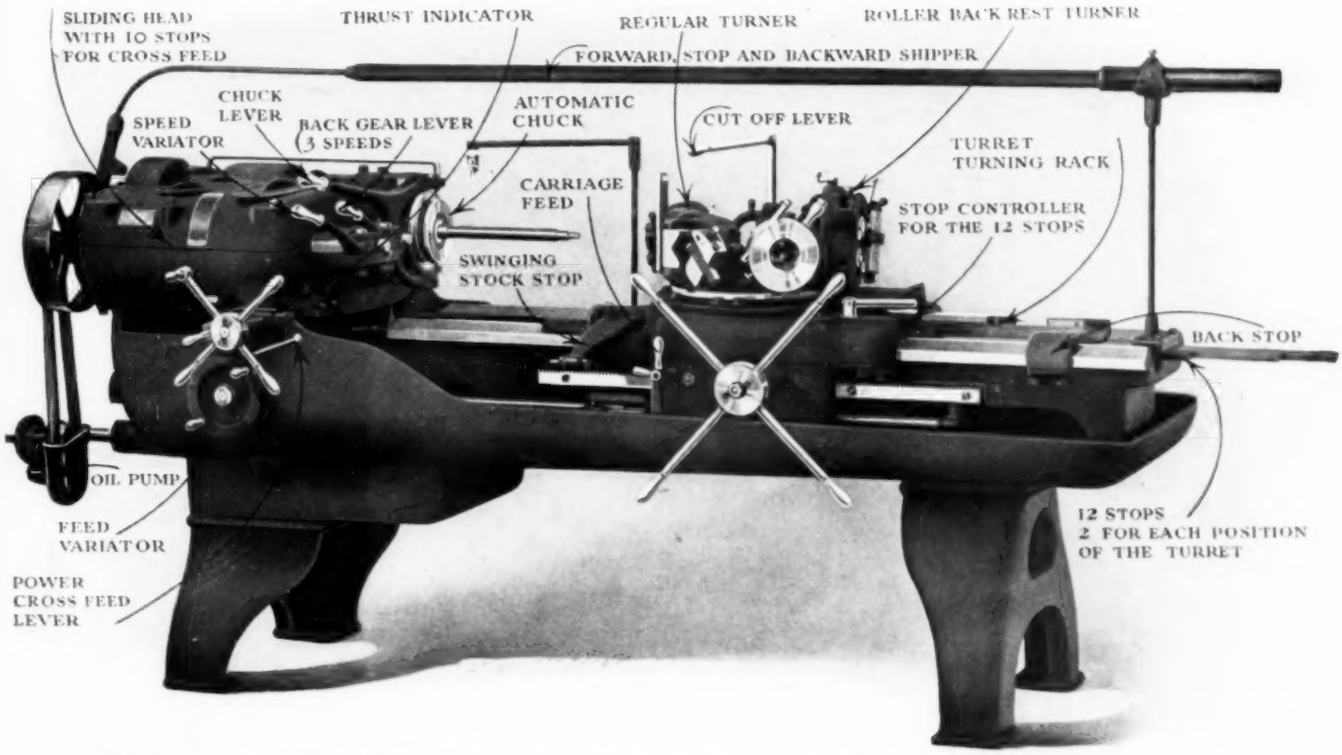
Flat Turret Lathe Simplicity Is Easily Evident



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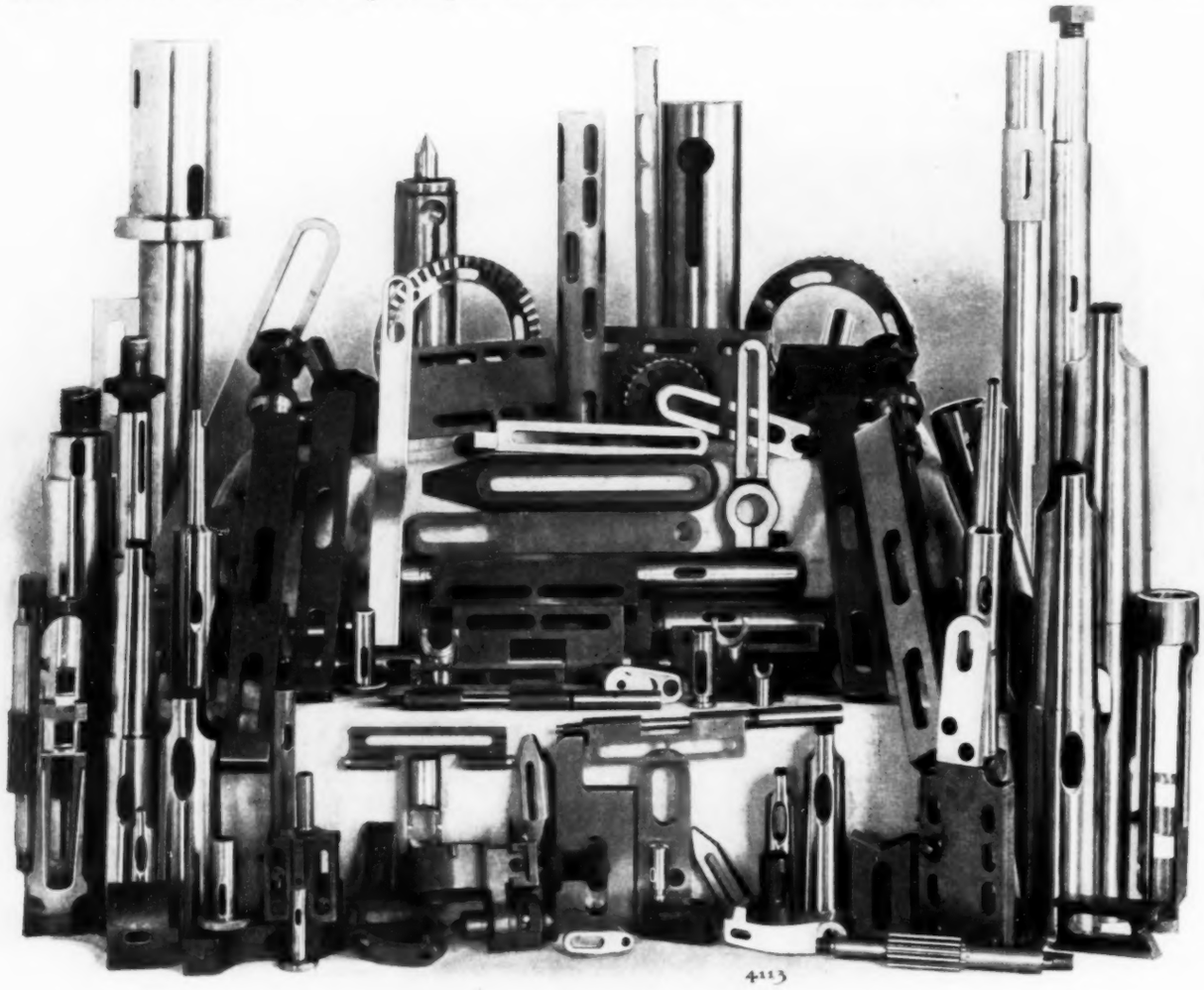

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This machine, embodying new principles, takes care of work for which heretofore there has been no suitable machinery.

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The great advantage of this tool will appeal to the manufacturer who has formerly been compelled to resort to expensive broaching operations or to hand milling for cutting keyways with closed ends, and tang slots which owing to their depth require extreme care in manipulating of tools as well as the continuous services of a skilled operator.

Complete description with illustrations, pages 1 to 5, American Machinist, July 2, 1908.

Write for new illustrated catalog "The Spline Milling Machine."

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Tools and Methods of the E. Howard Watch Co.*

Grinding Machine and Miller Attachments and Some Bench Lathe and Other Appliances Used in Connection with Accurate Watch Work

BY F. A. STANLEY

Readers of the AMERICAN MACHINIST will recognize the fact that in an establishment like that of the E. Howard Watch Company at Waltham, Mass., devoted wholly to the manufacture of a high-grade product, there must necessarily be employed more interesting methods, more ingenious machines and tools than could possibly be illustrated fully in any one article or even series of articles of normal extent. Consequently, no attempt will be made here to describe in detail the successive processes involved in the manufacture of the Howard watch. Quite a number of the special tools utilized in this work will be illustrated, however, and some of the methods utilized for making such tools and keeping the general equipment in order will be set forth here and in articles to follow in the near future.

In selecting material for illustration, which, through the courtesy of the E. Howard company, we have been able to do liberally, an effort has been made to include particularly features not only interesting because of their connection with high-class watch manufacture, but valuable also to others than watchmakers because of methods they are likely to suggest which are applicable to other classes of fine work.

First will be illustrated a number of appliances used in the tool room and machine shop which are naturally highly important departments of the watch factory, as here all models, special machines and tools are constructed, and the entire manufacturing equipment kept in order.

*Copyrighted, 1908, by Hill Publishing Company.

CUTTER-GRINDER FIXTURE

Fig. 1 shows a cutter-grinding attachment which assures each tooth of a mill being correctly ground, and obviates the necessity of holding the tooth against a rest. The spindle is shown with a spiral end mill in position for grinding. The cutter spindle passes through a hollow spindle carrying on its rear end a collar in which are formed cam grooves or guides to give the necessary rotary movement to the work as it is slid to and fro past the wheel. The notched disk and latch at the end of the work spindle allow the mill to be indexed readily to present the teeth successively to the wheel. Index disks may be changed to suit different numbers of teeth on the mill, and both right- and left-hand spiral teeth are accommodated by the spiral guide grooves which are in opposite direction. These grooves are cut to three different angles of helix corresponding to the angles to which the end mills are commonly cut. The attachment is readily adjusted for any job of this nature which may come along.

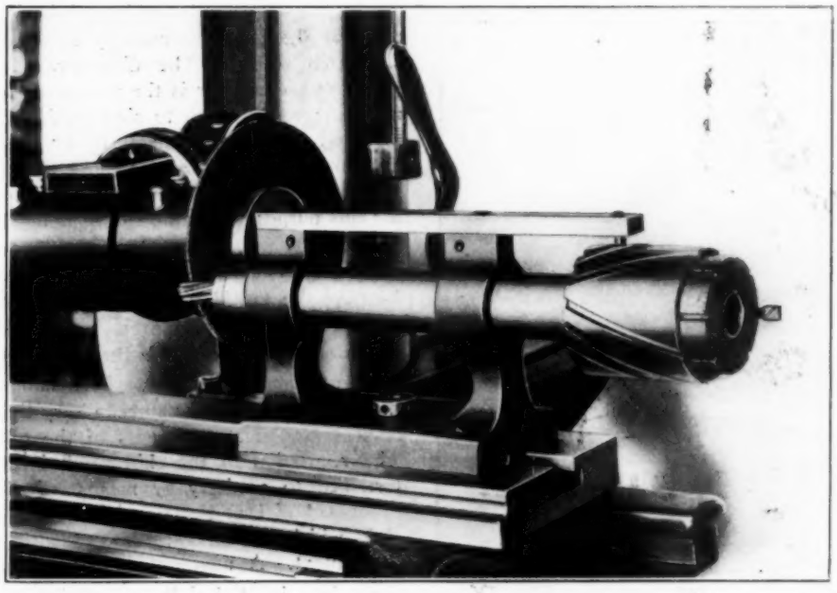


FIG. 1. CUTTER-GRINDING ATTACHMENT

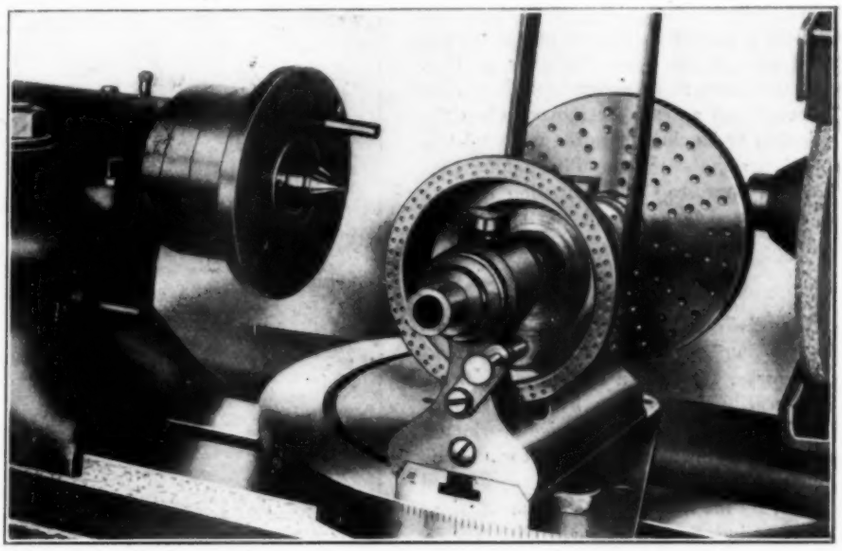


FIG. 2. GRINDER ATTACHMENT FOR CARRYING BENCH LATHE HEAD

SWIVELING ATTACHMENT FOR GRINDER

The grinder attachment in Fig. 2 enables a bench lathe head with the work in place to be located directly upon the platen of the regular grinding machine and quickly adjusted to any angle to which it is desired to grind the face of the work. The pivoted block mounted upon the graduated base plate is of the same section as the bench lathe bed. It requires but a moment to clamp the head on the swiveling block, adjust the latter, attach the belt and commence grinding operations.

Grinding Quill for Screw-Machine Chucks

A convenient device for holding screw-machine collets while grinding out the hole to size is shown in Fig. 3. This particular tool is adapted to receive a Brown & Sharpe No. 00 automatic screw-machine collet after it is hardened, and hold it during the grinding operation in precisely the same manner in which it will later be held in the screw machine when in operation. The quill in which the spindle is carried is slipped into a regular quill rest on the bench lathe or grinder, and the collet to be ground out is readily inserted and as easily removed when the grinding or lapping operation is completed.

All parts, including quill, spindle, rear bearing, cone, cap and adjusting nut are of steel hardened, ground and lapped.

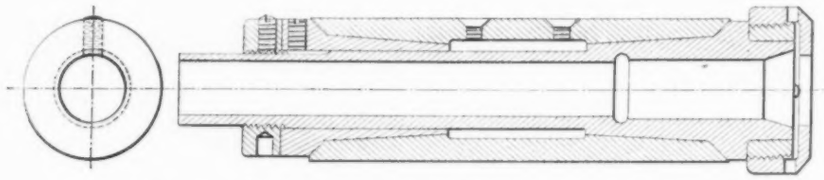


FIG. 3. GRINDING QUILL FOR SCREW-MACHINE CHUCK

A Dividing Head

The dividing head in Fig. 4, which was built a number of years ago at the Howard works, has quite a reputation as being an exceedingly accurate head, and on it has been done some very nice work, not only for its owners, but also for outside shops. Its construction is represented clearly by the half-tone. The worm wheel made in halves was hobbed and rehobbed with the two sections in various positions relative to one another before permanently fastening them together. The spindle on which the worm wheel is mounted is fitted in a quill secured in a seat in the head by two cylindrical clamps with nuts at the under side.

The large dial on the table screw of the miller shown in this view is graduated to give readings in metric thousandths, that is, in thousandths of a centimeter equivalent, of course, to hundredths of a millimeter.

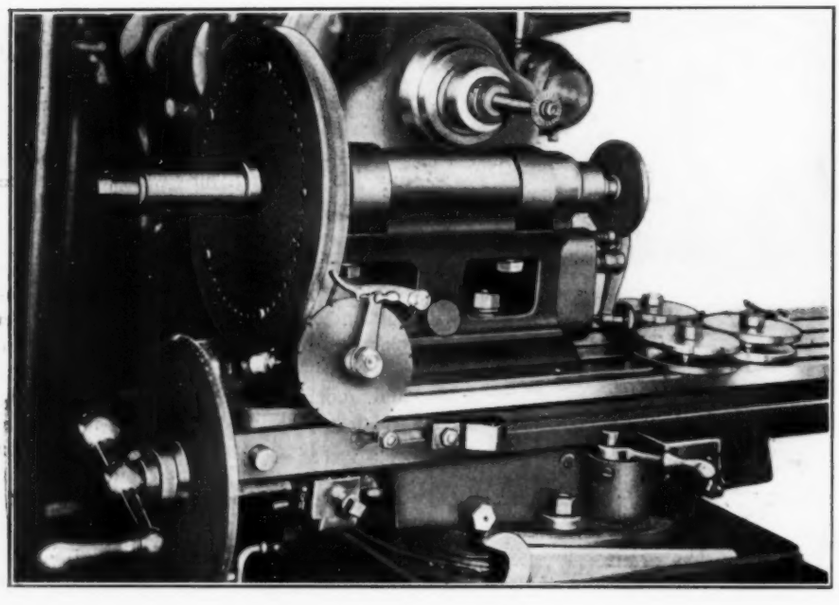


FIG. 4. A DIVIDING HEAD

A Hand Lathe for Master Taps

One of the most interesting features of the tool room is a lathe for cutting small master taps used for tapping master dies, which in turn are utilized for making taps for regular shop usage. This lathe is illustrated in Fig. 5. It is not over 8 or 10 inches in length, and is operated by the crank at the end of the spindle which, by means of change gears, rotates the lead screw for the tool slide.

The work threaded in this lathe is small and the threads very fine; 100, 120, 180, 200 and 240 per inch representing some of the pitches commonly employed on watch screws. The diameters (for which the centimeter is the unit of measurement) range down to sizes equivalent to one-hundredth of an inch or less. To thread taps of these minute dimensions requires a sensitive machine and for this purpose the lathe shown is highly satisfactory.

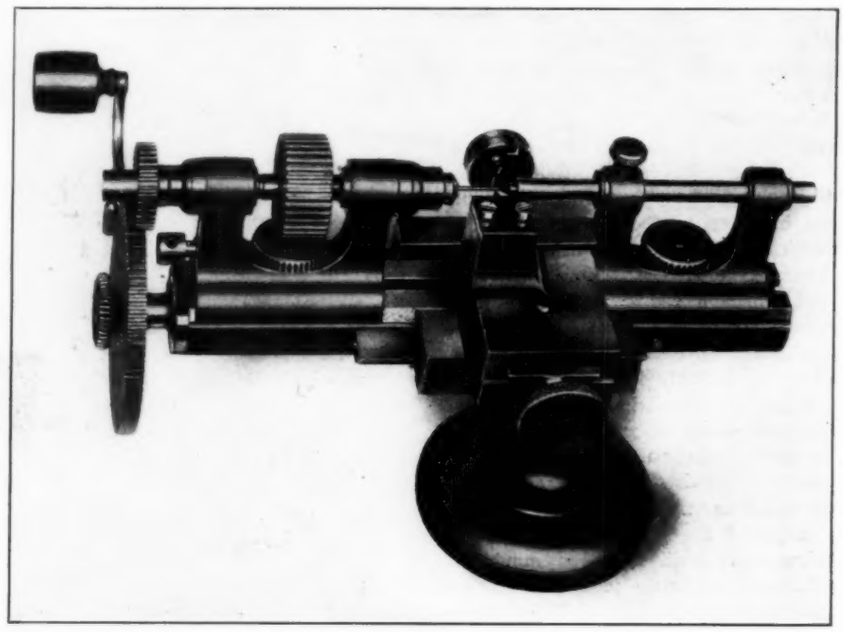


FIG. 5. HAND-OPERATED LATHE FOR CUTTING SMALL TAPS

The outer end of the piece of wire forming the tap blank to be threaded is pointed and supported in a female half center and the chuck holds the work true. The threading tool is kept keen and to the correct angle and naturally very light cuts are taken at each pass of the tool. The regulation of the chip depth is determined to a nicety by means of the graduated dial at the rear of the cross-slide which has an exceedingly sensitive adjustment. A man accustomed to this lathe will make a tap quickly and accurately no matter how small it may be or how fine the thread.

Keeping the Thread Tool in Order

The thread tool for this lathe is kept in condition by a disk lap charged with diamond dust. The tool is held in a box wood block so formed that when the block is held against the revolving, diamond-charged disk the tool will be lapped accurately. It has been found that the wear on the boxwood block due to the abrasive is less than on a hardened steel block, in fact is negligible.

Grinding Taps

The taps used in watch work are flatted on three sides to present as many cutting edges. The flatting operation is performed after hardening by holding in a tool, Fig. 6, having a body of triangular section and a small chuck for gripping the work. The holder is placed on a rest beside the grinding disk and held successively on the three broad faces until the flats are ground, after which it is rested on the narrower faces while the ends of the lands are ground back to give relief to the starting edges. The flatting operation, like the threading, is done with the aid of an eyeglass; in fact, most of the work on such small tools, as well as on watch parts in general, requires more or less constant use of the glass, without

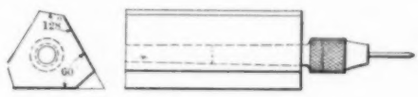


FIG. 6. HOLDER USED WHEN GRINDING TAPS

which instrument some of the parts can hardly be seen, and certainly not critically examined. The widths of the tap lands are gaged by the eye (aided by the magnifying glass), and continual practice on operations of this kind makes possible results whose accuracy could hardly be exceeded by strictly mechanical processes.

Watch-screw Threads

Watch-screw threads are usually 45 degrees sharp V-form, except where tapped in steel, in which case they are sometimes, if not always, 60 degrees included angle. The 45-degree angle gives increased depth to the threads, and while they are actually of very fine pitch, relatively to the diameter of the screw they are quite coarse. This fact is shown strikingly in Fig. 7, which represents a number of screws regularly used in the Howard watches. A few general dimensions are given showing the sizes in thousandths of a centimeter, while the bracketed figures are the equivalents in thousandths of an inch. It will be noticed that some of these threads cut 180, 200, and even 240 to the inch, appear almost as coarse as wood-screw threads, owing to the small diameters of the pieces on which they are formed. The wire sizes given are to the Stubs' steel-wire gage. While the dimensions to which watch screws are generally finished are in accordance with the metric system, the pitches are expressed in threads per inch.

Small Screws

The screws in Fig. 7 are all shown to large scale, and until the dimensions are examined their minuteness is not fully realized. The pallet cap-screw in the upper left-hand corner has an over-all length of 0.034, or practically 1/32 inch, of which 0.20 represents the length of thread and 0.014 the thickness of head. Although the latter is actually under 1/64 inch in thickness and less than 3/64 inch diameter, it is beveled accurately to an angle of 45 degrees. The thread itself is 0.022 inch diameter and cut 220 to the inch. Another interesting example of small screw work is the micrometer-regulating spring screw which, as will be seen, has two slots and two holes crosswise of the head for facilitating sensitive adjustment. The screw proper is practically 1/64 diameter and the head 3/64. Still another screw of interesting proportions is the one in the lower right-hand corner of the engraving.

Tools Used in Watch Manufacture

Some typical jigs and fixtures employed in the machining of watch parts are illustrated in Fig 8. At *A* in the half-tone is shown an appliance known as a depthing chuck, the various parts of which are shown in the upper portion of the engraving. The chuck is attached to a spindle fitted in a quill which runs in the quill rest of the bench lathe. For a certain type of watch there may be as many as 24 such chucks, each of which is self-contained and ready for operation the moment it is slipped into the quill rest. This

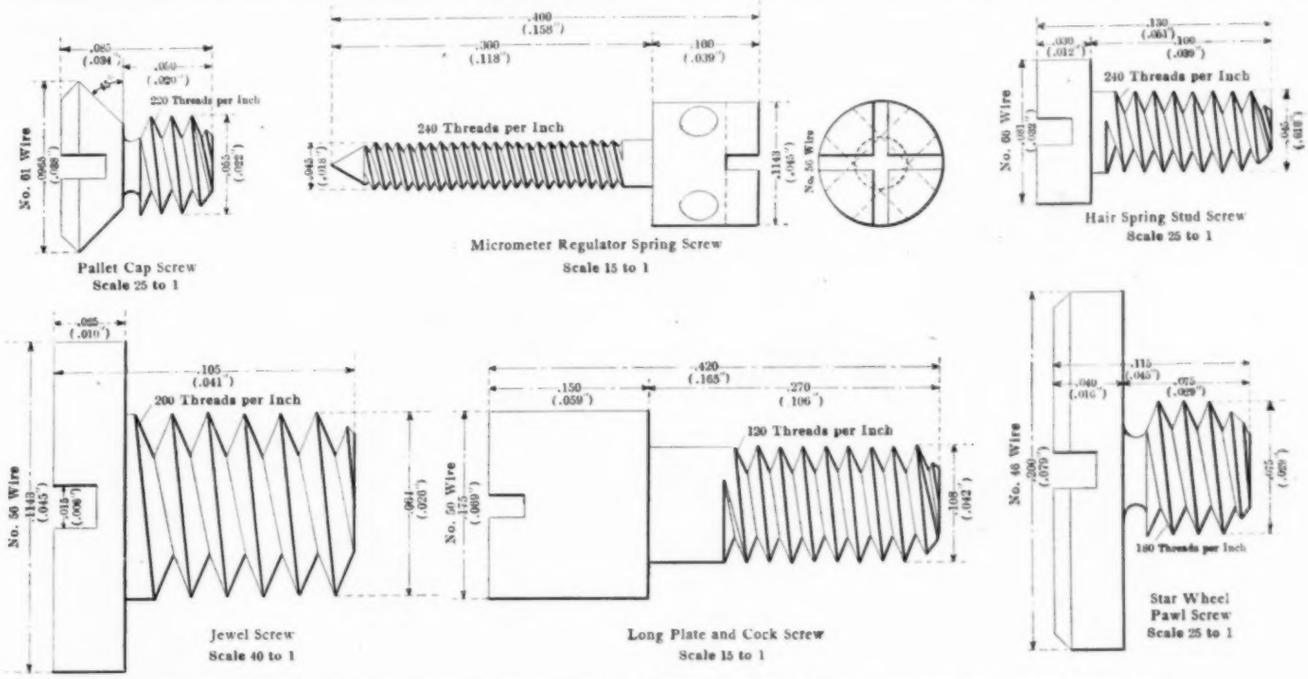


FIG. 7. WATCH SCREWS—DIMENSIONS REGULARLY GIVEN IN CENTIMETERS—FIGURES IN PARENTHESES ARE EQUIVALENTS IN THOUSANDTHS OF AN INCH

type of tool is used when cutting out various holes, recesses, and openings formed in the main plate of the watch, which is a circular plate of nickel upon which is mounted all the mechanism. The sketch of the plate in Fig. 9 gives an idea of the relative location and sizes of some of the "sinks" or recesses referred to. There are numerous other recesses actually formed in the plate before it is finished; some cut in one side, some in the other, besides a

large number of holes that are opened clear through the plate. The sketch merely suggests the general character of the plate with no pretense toward completeness or accuracy of detail. The three post or pillar holes near the periphery are drilled in the plate first and then used for locating it on the depthing chuck, which carries three pins corresponding in size to the plate holes. These holes, by the way, are not spaced equidistant, for, if they were, it would be an easy matter to locate the plate in the wrong position which is an impossibility with the slightly irregular spacing.

Construction of the Depthing Chucks

The construction of this type of chuck will be understood upon examination of the details in Figs. 8 and 10. One of these chucks is provided for each recessing operation and for each important hole; that is, each chuck of the set, numbering, say, 24 in all, gives the work a definite position off center, differing from the positions obtained by means of the other chucks. Thus the position of any hole formed by means of the chucks is positively determined relatively to the center and to the other holes, and the center distances from one hole to another in the finished work must necessarily be correct.

The body of the chuck proper is shown at *B*, Figs. 8 and 10. In this member is formed a channel which is eccentric to the center and receives cam ring *C*. The three cam slots in the latter are adapted to engage the spherical ends of pins passing through clamp jaws *D*, which are mounted in holders attached to chuck body *B*. When shell *E* is turned by the hand, cam ring *C* is operated by a pin entering a slot in the rear wall of *E* and in turn operates the three clamp jaws *D*, whose notched ends engaging the circular piece of work draw it fast against the locating plate *F*. Cover plate *G* is attached as shown at the front of the chuck and gib ring *H* at the rear.

The method of mounting the chuck on the spindle and the spindle in the quill, as well as the driver for operating the chuck when the latter is slipped into the quill rest is illustrated fully in the engraving. A few over-all dimensions in inches are included in this illustration and on other tool drawings shown.

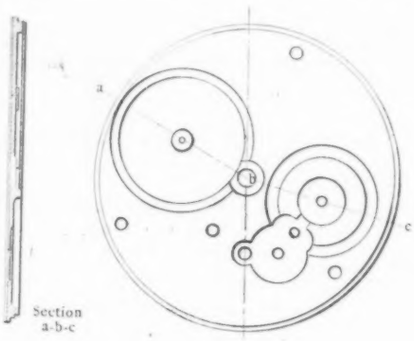


FIG. 9. WATCH PLATE

Drill Jigs

The drill jigs occupying the lower portion of the engraving, Fig. 8, are of an interesting type used extensively at the Howard shops. These jigs hold the work squarely against a seat profiled to conform to one edge of the piece to be drilled, and the single operation of closing the jig by the hooked cam handle fastens the work in place also.

It will be seen upon inspecting the views of the open jigs that near the front of each is a pivoted member, which, when the jig is closed is pressed against the outer edge of the work by a wedge-shaped pin secured in the upper left-hand corner of the jig leaf. These pivoted clamping pieces *I* and *J* are spring-tempered and thus the work is held easily though securely in the seat with an even pressure, and all possibility of distortion which might be caused by direct-acting clamping screws is avoided. At the same time a very compact construction is obtained without projecting clamping screw or devices of any kind with the exception of the handle by which the jig is manipulated.

A Fixture With Self-acting Clamp

The tool at *K*, Fig. 8, is an appliance used in the quill rest of the bench lathe, for boring the hole for the stem of the watch. Several such fixtures in different positions are illustrated in Fig. 11 and one of them is shown opened with the work in place and with the hole already bored in the periphery from the front. This form of tool is automatic in its clamping action; it grips the work the instant the spindle is started and holds it securely so long as it is rotating.

Referring to the drawing, Fig. 12, it will be observed that the hook clamp *L* is mounted on an eccentric pin *M* carried by pivoted jaw *N* and carrying a plate *O* which acts as a weight and which, when the fixture is set in motion swings outward by centrifugal action and causes eccentric *M* in conjunction with hook clamp *L* to draw loose jaw *N* tight against the work and so clamp the latter against the fixed plate *P*. This plate is fitted with locating pins to position the work correctly.

When the spindle is stopped, with the loose jaw *N* at the top, the weight *O* drops back to normal position releasing the hook clamp and allowing the fixture to be opened for the removal and insertion of work. The device is rapid in its

FIG. 8. JIGS AND FIXTURES FOR WATCH MANUFACTURE

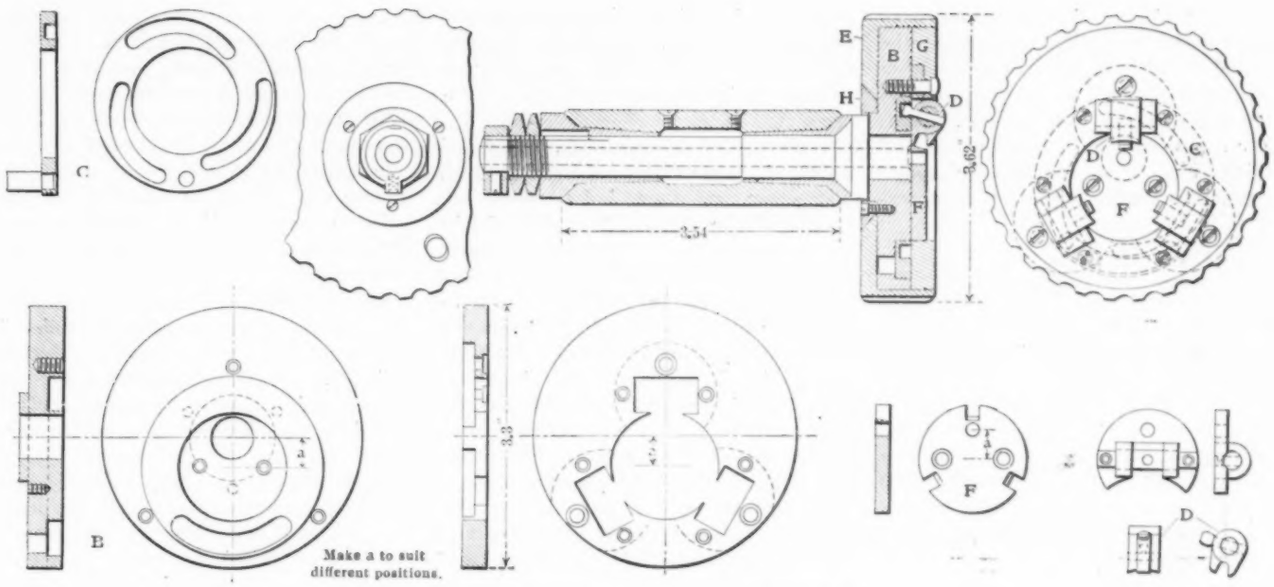


FIG. 10. DEPTHING QUILL CHUCK DETAILS

operation and forms another instructive example of a method of clamping work adequately without possibility of distortion.

A Pump Center Head

A head used where it is desired to center a plate by a hole already bored in order to open out that hole, or enlarge it concentrically from one side, is shown in Fig. 13. The chuck body *Q* mounted on the bench-lathe spindle nose carries three plugs *R* to whose outer ends is attached plate *S*, on which plate is formed a spherical projection fitting a similarly shaped seat in plate *T*. Threads are cut on plugs *K* as indicated in the assembled view to suit operating nut *U*, and the latter thus forms a means by which the plugs and plates *S* and *T* may be adjusted outwardly to clamp the work against the inner face of fixed plate *V*.

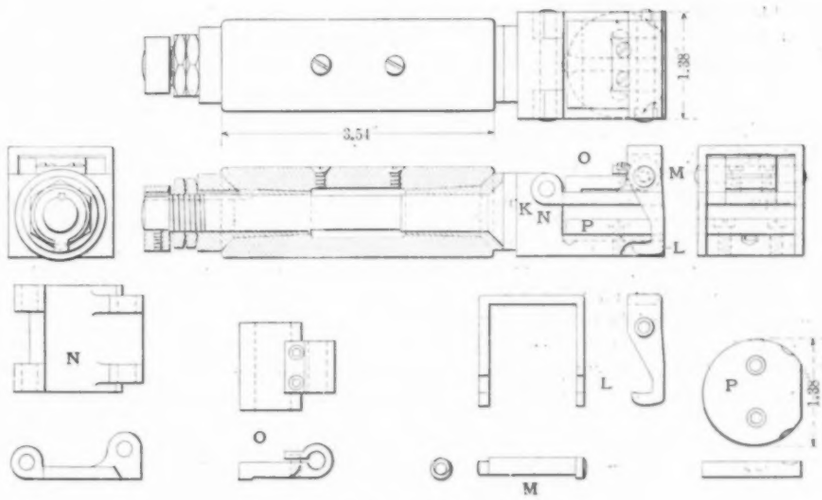


FIG. 12. DETAILS OF STEM QUILL.

The work is slipped into the chuck through the opening *W* at the side and is centered against the inner face of front plate *V* by center *X* which is engaged with the hole which is to be operated upon. Nut *U* is then turned to force plate *T* forward and clamp the work against the front plate. The center is then drawn back and the operation on the piece proceeded with, the opening at the center of plate *V* having a sufficiently large diameter to give ample room for the tools employed. The spherical connection between the two members of the clamping plate allows a perfect bearing to be obtained always against the back of the work.

A Grinder Head and Spindle

In Fig. 14 is illustrated a spindle as applied to the head of a light grinding and

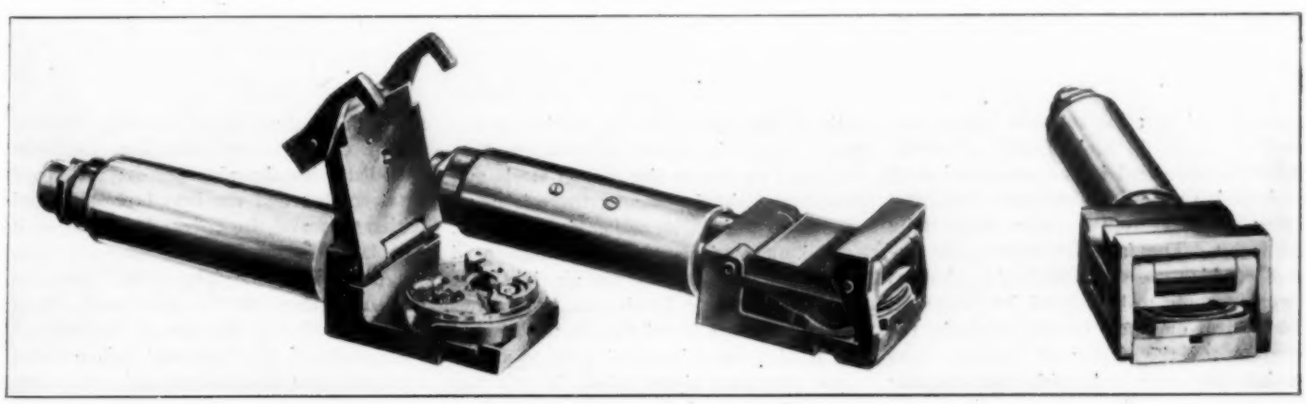


FIG. 11. QUILL FIXTURES FOR BORING WATCH STEM HOLES

polishing machine. The front bearing, as will be noted, is double-coned, while the rear end has a plain, cylindrical bearing in an adjustable box. The end thrust is thus taken care of at the front bearing, obviating all possibility of cramping or end binding action on the spindle which might otherwise be brought about by linear expansion due to heating while operating at high velocity.

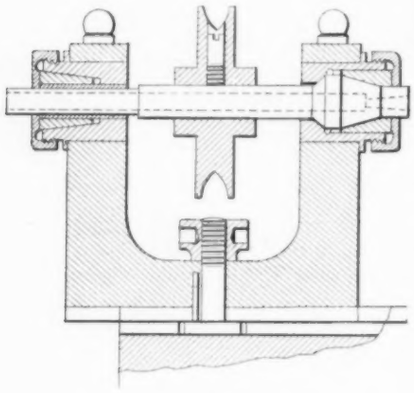


FIG. 14. HEAD AND SPINDLE OF DOUBLE ROLLER GRINDING AND POLISHING MACHINE

Accuracy in Tools and Product

The different tools described for bench lathe and other operations in connection with watch-movement manufacture are as accurate as it is possible to construct such tools; which means that the errors, if any exist, are entirely negligible. Parts subjected to wear are of steel, hardened and ground, with locating surfaces lapped true and an especially high quality of workmanship is utilized in the construction of such tools as the depthing quill chuck and other fixtures used in the bench-lathe quill rest. The fact that these quill fixtures (which are self-contained appliances requiring only to be slipped into the quill rest) are operated freely through the medium of the driver at the rear end which is connected with the regular bench-lathe spindle, assures their proper operation without possibilities of inaccuracies which might arise were a direct-belt drive employed. The service on these chucks is such that once properly constructed their accuracy is maintained indefinitely.

Various holes in main plate, bridge and cocks, which are afterward to be jeweled, and other important holes which are bored with the plate held on quill chucks of the type just referred to, are accurately put through by tools which in many cases are carried in holders resting in the half-open type of tailstock. The drills for this purpose are generally flat and made from wire which is kept in stock of various sizes and of the right length for drills as well as for the small taps referred to at another point in this article. For finishing some of the holes the flat drill is ground away on one side, leaving only the front lip which acts as a single-pointed tool for boring the hole dead in line and exactly to size.

All of these fixtures, jigs and other appliances wherein a watch plate or some other member must be correctly positioned for undergoing operations are made with the aid of master plates so that locating pins, bushings, etc., are accurately located throughout the entire series of tools included in the manufacturing equipment. A description of these master plates and some methods employed in making them will be given in another article.

Annealing High-speed Steel

By K. Charles

The annealing of high-speed steels seems to be an obstacle of concern in the path of the general hardener, but it has been my experience that it is about as easy to anneal as any of the carbon steels and much more simple, because there is never any danger of its becoming decarbonized.

While a good way to anneal high-speed steel is to pack it in an air-tight box with either charcoal, asbestos, lime, ashes or sand, I have found that in the general run of shops one is called upon to anneal some piece or pieces when it was too late to box-anneal them. On one of these occasions I took a chance and put the pieces on the furnace floor and brought them to a bright red heat, that is, about 1500 degrees Fahrenheit, and then shut the furnace down, leaving them there until the next morning, and the result was that they were as soft as could be desired.

In annealing high-speed steel in this manner care should be taken to put the articles as far back in the furnace as possible, so that the cold air will not reach them too early when they are cooling off.

I have often annealed articles, in this manner, over the noon hour and finished the process by burying them in ashes or giving them a soapy-water anneal. The steel should be allowed to cool to a black heat before it is removed from the furnace.

While the above process may fill the bill, I am not prejudiced against the packing process of annealing, but how often is the hardener called upon to anneal a piece when his furnace is so full of boxes that it is absolutely impossible to put another one in. Such situations do not bother me, as I now know that I can lay them on the bench until it is near time to quit, when I can put them in the furnace and they will be O. K. in the morning.

I had a case recently in which both my method and the charcoal pack failed me. This piece was a small ingot of steel, very high in vanadium, that had not been forged, as it was a test piece taken from a cast by the chemist, to be analyzed.

To anneal this I took a box that was about 6 inches larger than the piece of steel. I then took a pine board, 1½ inches thick, and sawed it into lengths that would form a loose box around the steel. The steel piece was then located in the center of the iron box and surrounded with the pine pieces; the space between that and the iron box was filled with ashes and the cover sealed on with fire-clay.

I put this in the furnace and kept the heat on it about six or seven hours, so as to be sure that it was hot all through. I then shut off the heat and left it there until the next day, and when it was taken out found that it was as soft as could be desired.

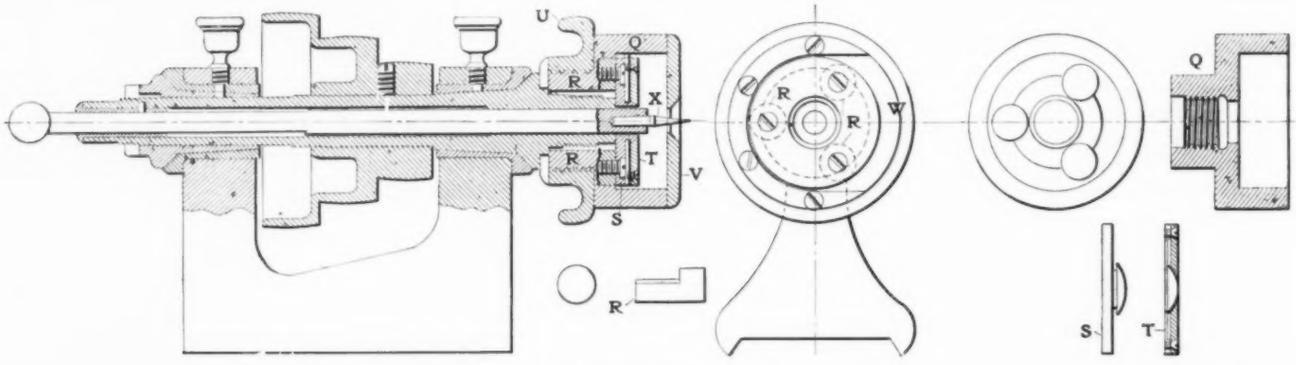


FIG. 13. PUMP CENTER HEAD

A Design for a Plain Milling Machine

A Constant Belt Speed with Sixteen Changes and All Gearing in an Interior Box Fitting Into the Main Frame with All Gears in Oil

BY H. F. NOYES

This machine was designed for a positive-driven, constant-belt speed, plain machine, for general manufacturing purposes, having a range of 24x7 inches, with table feed in one direction.

Some of the other points which were sought in this design were positive feeds, a belt speed of about 1000 feet, easy accessibility of table mechanism, all operating handles and speed-controlling mechanism, the collection of the speed- and feed-varying mechanisms on the left-hand side of the machine, and in connection therewith a design which should leave the outside of the bed practically a plain surface free from the multiplicity of brackets, bulges and irregular projections so common to nearly all the present types of milling machines.

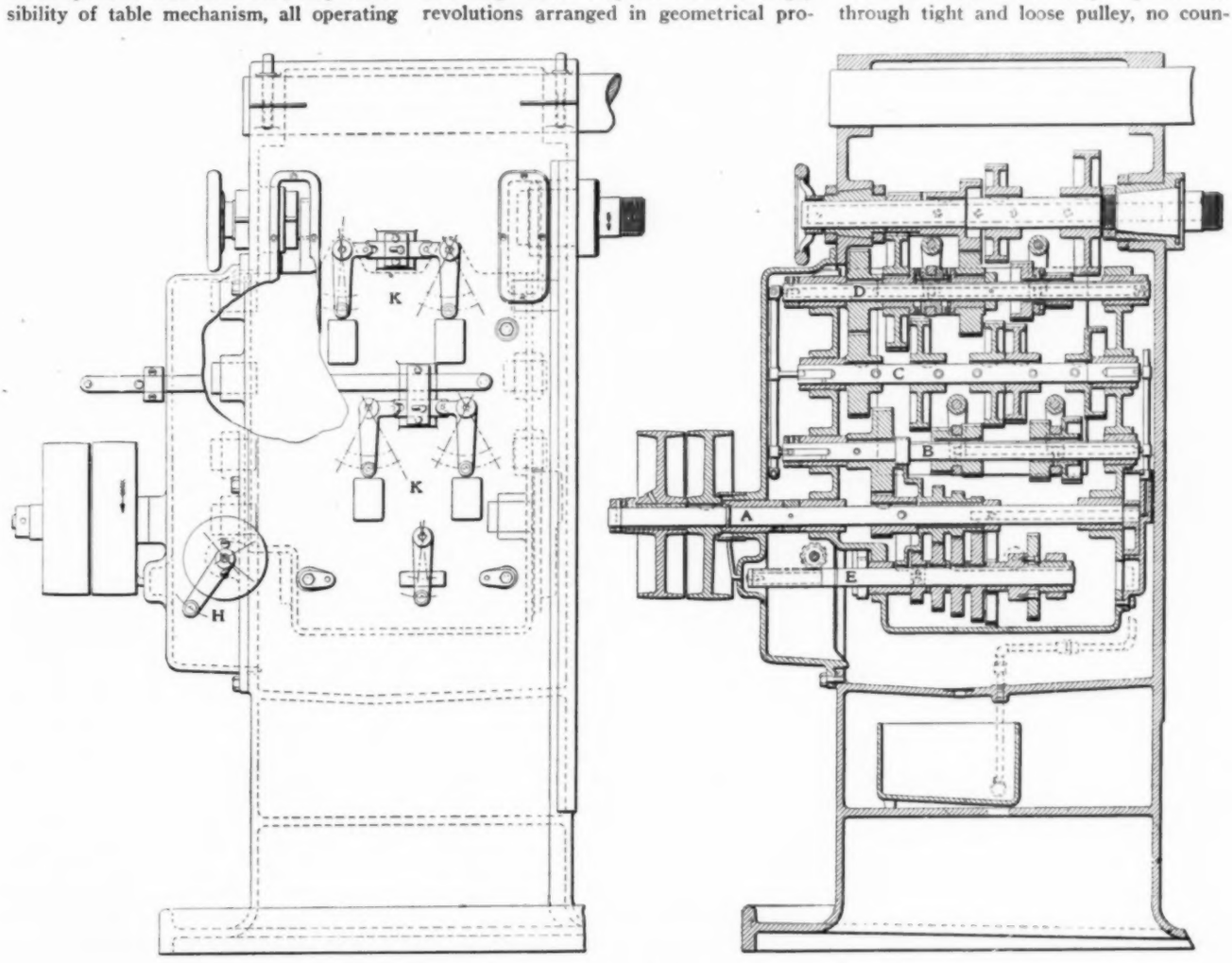
With reference to the drawings for this machine, Fig. 1 is a slide and Fig. 2 a side section of the machine. Fig. 3 is a rear sectional elevation and Fig. 4 is a rear elevation taken with the back plate removed; Fig. 5 is a part sectional plan with the table removed.

The spindle speeds decided upon as most suitable for a machine of this type and range were 16 speeds from 20 to 327 revolutions arranged in geometrical progression with a constant increase of 20 per cent.

The feeds were made wholly independent of the spindle revolutions, and are eight in number, from ½- to 12-inch table travel per minute, having a uniform increase of 50 per cent.

The main driving shaft runs at a speed of 375 revolutions, giving a belt speed of 1075 feet. The speed changes are made through a system of sliding gears and the feed changes through a sliding key and clutches. This design makes it possible to place practically all the shafts in one vertical plane carried by a case of regular form, closed at the bottom that it may be partially filled with oil, self-contained, so that it can be assembled outside the bed, and then lined up and doweled in place.

The machine is driven by a 3-inch belt through tight and loose pulley, no countershaft being necessary. In this reference, while there is today a leaning toward the use of a clutch for driving machine tools, and many of the newer machines have been so designed, it is a debatable question to the writer whether the advantages gained compensate for the disadvantages attendent upon its more complicated mechanism. The chief recommendation is that it is faster, but on the other hand, it is more complicated, more expensive, more trouble to take care of, and



FIGS. 1 AND 2. GENERAL AND SECTION VIEWS OF PROPOSED MILLING MACHINE

more frequently out of commission. The clutch must have a loose-running member which is always open to the objections of the loose pulley. It has to be frequently adjusted, and for any speeds above 200 revolutions must be of a friction type, which, after becoming worn, is likely to either stick or fail to pull. The loose pulley, on the other hand, is simple, inexpensive, and if properly designed and oiled, is seldom a source of trouble.

The main shaft *A*, Fig. 2, which carries the tight and loose pulleys, is geared to one of three intermediate shafts, which are arranged in line above it with a set of four gears on each shaft, the last set engaging a set of four gears which are all keyed to the spindle. The shaft *B* carries two sets of sliding gears adapted to engage a set of four on the shaft *C*. This shaft is geared to the shaft *D* which carries one set of sliding gears and a set of clutch gears, adapted to engage the four gears which are keyed to the main spindle. This arrangement gives a range of 16 speeds with a simple and straightforward design of case, and while this number of speeds can easily be worked in with a less number of gears, it is at the expense of simplicity of machine operations. With this design the work is practically all lathe work and gear cutting, the least expensive of machine work.

Each pair of sliding or clutch gears is operated by a lever, four levers in all, arranged so as to be reached on the left-hand side of the bed. To prevent two gears on the same shaft being engaged at one time, its two levers are provided with a slide shown in Fig. 1, which always locks one from movement.

Driven from the shaft *B* and running loose on the shaft *A* is a cone gear of five steps, four of which engage four loose-running gears on the shaft *E*. The latter shaft is adapted for longitudinal movement and carries a spring-pressed plunger which is adapted to engage in turn either of the four gears. This shaft is made proportionately large in diameter in order to accommodate a substantial plunger or key, and is hardened as is also the plunger and gears. Three beveled washers are placed between the gears and serve to pull the key out of engagement with one gear and hold it out as the shaft is slipped through until the plunger drops into engagement with another gear. For a back-geared arrangement this shaft carries a small and large gear, arranged to slide on the shaft and provided with a roller in place of the usual key in order that the shaft may be easily moved. These two gears engage a pair of gears which are loose on the shaft *F*, and which a sliding clutch keyed to this shaft is arranged to engage.

To obtain the eight changes of the feed mechanism, two levers are provided, one giving a fast and slow speed by shifting the clutches on the shaft *F*, and the other operating a rack which is loose on the shaft *E*, and which moves the latter longitudinally. This lever has four stops, each stop giving one of two speeds according to the location of the clutch lever. These shafts *E* and *F* run in oil, and the speed changes can be made without stopping the machine.

While the sliding internal clutch or key has been objected to, if it is made of substantial proportions, and all the parts hardened for slow and medium speeds when applied to feed mechanisms, it makes a very simple and desirable arrangement, and in case of repairs can be made easily interchangeable and easy to replace. By arranging four keyways in the gears the wear on the latter is reduced so as to become a negligible quantity.

The end of the main shaft *A* is connected with an eccentric oil pump which

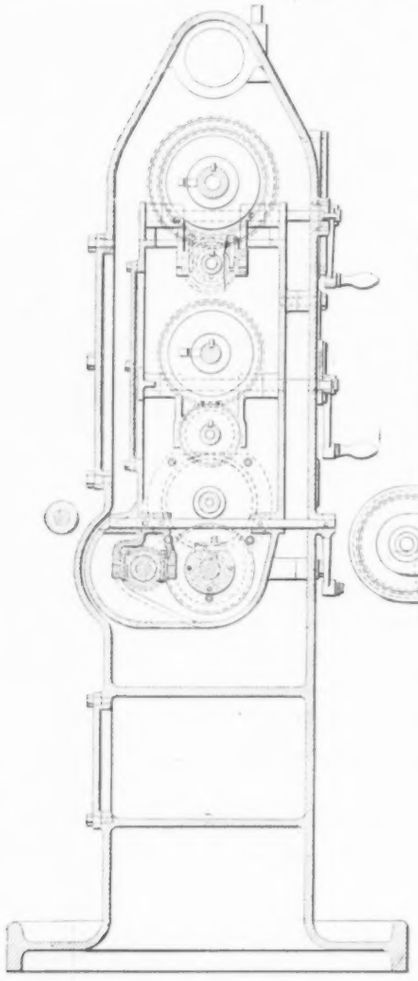


FIG. 3 CROSS SECTIONS THROUGH BED.

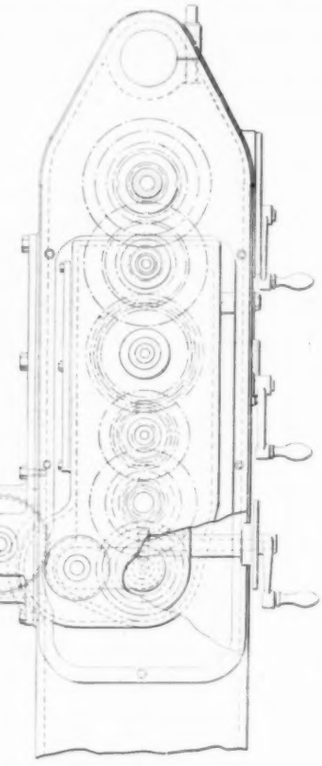


FIG. 4

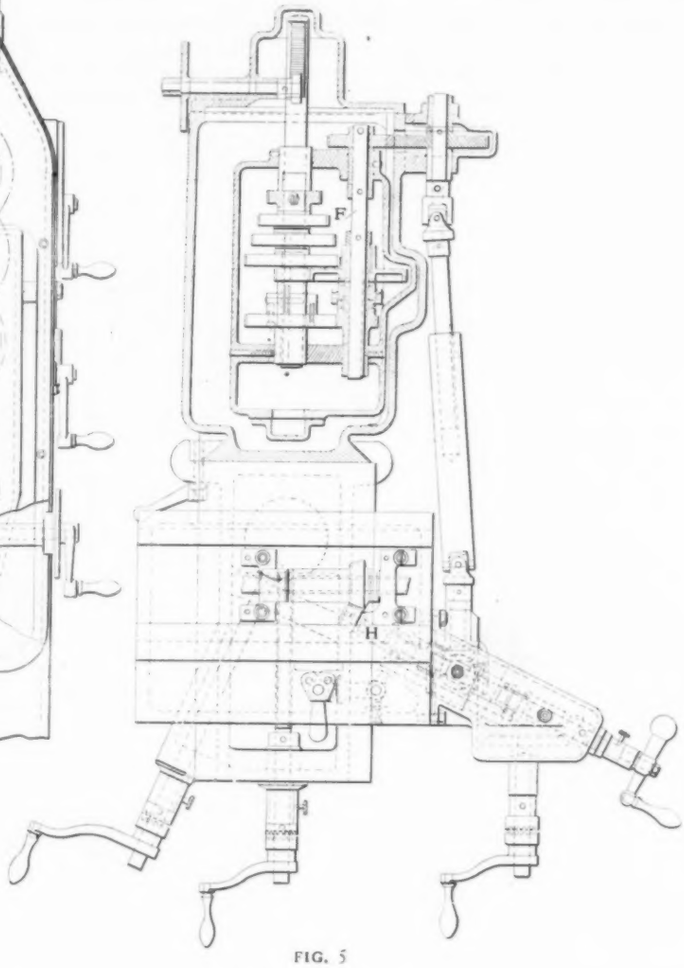


FIG. 5 FEED MECHANISM AND TABLE

is fastened to the case. From this pump oil is piped to all the inside bearings of the bed and to the loose-running gears from the hollow shafts, returning to a tank which is located underneath the gear case. By this construction, with the lower gears running in oil, a very efficient oiling arrangement is obtained.

The shaft *F* is connected through universal couplings with a short vertical shaft which, through a connection of bevel gears and clutches, drives the shaft *H*, shown in plan view in Fig. 5. The two bevel gears on the shaft *H* are running loose, and by engaging the clutches with one or the other of them this shaft is run in either direction; a stop on the table is adapted to engage a lever on the saddle which is connected with these clutches and operates to move them as may be desired, or to disengage them automatically.

This arrangement brings the table-operating handles all within easy reach of the operator, and provides a quick return for the table, which is carried independently of the table and does not follow its movement so that the operator can stand in one position and easily reach all handles at all times.

Some of the main dimensions of this machine are as follows: Length of automatic table feed, 24 inches; cross movement of table, 7 inches; vertical range, 15 inches; size of table, 38x9 inches; table working surface, 32x8 inches; taper hole in spindle No. 10 B. & S.; spindle bearings, front, 3 3/16x4 inches, rear, 1¾x4 inches; width of driving belt, 3 inches.

In the course of an interesting paper on the application of color photography read before the Iron and Steel Institute it is stated that with the new autochrome plates introduced by Messrs. Lumiere, of Lyons, France, whose process is simply a modification of the three-color process, it is now possible to obtain a photograph in color on a single plate and in a single exposure without difficulty. The process comprises a film form of transparent starch grains of uniform size and colors respectively red, green and blue, and mixed in the proper proportion to produce white places in the front of the ordinary photographic film. Through this film of colored particles all the light has to pass in order to reach the regular film, and the light is, therefore, resolved into its components.

The Treasury Department at Washington adopted last year specifications for high-pressure cylinder oil which requires refined petroleum oil mixed with 10 per cent. of acidless tallow with a specific gravity not less than 0.070 at 50 degrees Centigrade, and a flashing point not less than 285 degrees Centigrade, which seems to substantiate the faith in tallow held by many of the old-time engineers.

Safety Devices for Compressed-air Tools

By Robert Grimshaw

A writer in the *Deutsche Techniker Zeitung* calls attention to the numerous accidents that have taken place by reason of the faulty construction of compressed air tools (for instance riveters). As an illustration he gives well-known constructions—shown here in the cuts—and states that there are many forms of construction where, if the tool is not pressed to the work, both die and piston are shot from the cylinder. See Fig. 1. This is also the case where a workman, who does not understand the operation of a tool, touches the inlet valve or strikes it against something. The die and piston are shot out by the high pressure—usually about 5 atmospheres—to a considerable distance. Manufacturers of these tools have endeavored to prevent such accidents as far as possible.

FIG. 1

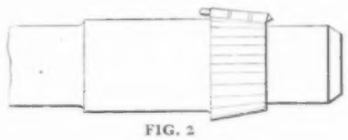


FIG. 2

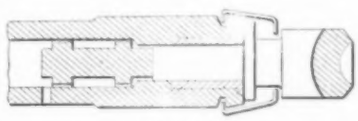


FIG. 3

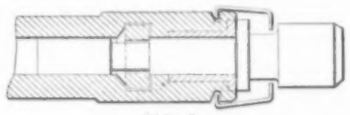


FIG. 4

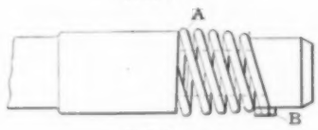


FIG. 5

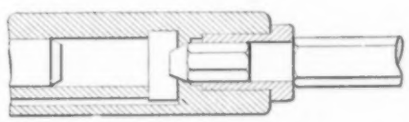


FIG. 6

SAFETY DEVICES FOR PNEUMATIC TOOLS

Some have attached the die to the body of the tool by a long leather thong. This cannot be considered as a measure conducive to very great safety, although it does prevent the die being lost when the hammer is used vertically as on bridge work. Others employ a jacket of thin sheet iron surrounding the body of the tool and the die, as shown in Fig. 2. Such a sleeve or jacket is, however, subject to wear and naturally is a source of safety only so long as it can withstand the pressure brought on it. Still better is the solution illustrated in Fig. 3. Here the bore of the working cylinder is at one portion of smaller cross-section than the rest.

Hammers that are already in use and have smooth bores have been altered by turning a groove therein and laying in this a two-part steel ring, thus preventing the plunger from coming out. Such a hammer is not altogether safe, as it often happens that the ring springs out. Fig. 4 shows this arrangement. More sure is the method shown in Fig. 5. It consists of a hardened-steel wire spring about 1/6 inch in diameter pressed firmly about the body of the hammer, held at *A* by a half-round groove and at *B* by a small screw. This arrangement acts as a buffer. If the piston strikes the die when the latter is not pressed against the rivet the spiral spring is brought into play and no damage ensues to the valves or the hammer.

An equally good arrangement to prevent the bolt from flying out acts by rendering it impossible for the latter to work at all unless the shank of the die is thoroughly air-tight in the hammer. This is, as a rule, only the case when the hammer is pressed firmly against the work.

Some accidents with such riveting tools are caused by the fact that the workman, while doing some trifling subsidiary work, leaves the air valve of the compressor open for a short time, either because the distance is too great or because, as is often the case in bridge work or on high buildings, it is difficult to reach. To prevent such accidents it is well to have a second valve near enough to the workman to give no excuse for such neglect. But such an extra valve should not greatly increase the weight of the tool and its freedom of motion.

Another way of doing away with the danger is to surround the valve with a sheet-iron casing of such size and construction that in order to reach the valve it is necessary to stick the thumb through a special opening. But even this does not preclude the danger of accident, as a sidewise slip of a tool weighing about 18 pounds renders breakage of the operator's thumb quite possible.

Where the pneumatic hammer is used for chipping and calking the piston does not fly out. Here, as is shown in Fig. 6, the tool has a six-sided shaft that is held firmly in the hammer body and has a smaller diameter than that of the bolt. Care should be taken that whatever hammer be used the possibility of the piston and die being shot forth is absolutely precluded.

Two Years of Co-operative Education*

A Story of Some Educational History in the Making, Including the Methods and Results and a Forecast of the Future of The System

BY HERMAN SCHNEIDER†

This paper will attempt to set forth briefly a few of the principal features developed during the two years of operation of the coöperative courses at the University of Cincinnati. For the information of those who are not familiar with this system a short statement of it will be given:

The General Plan

The coöperative courses as now operated contemplate that a student shall work alternate weeks in a mechanical, chemical, or electrical factory in Cincinnati and at the college of engineering of the University of Cincinnati. The class is divided into two sections, which alternate with each other during the collegiate year. During the summer, students are employed in the shops full time, but are given a vacation of about three weeks. The course in the shop is carefully planned, and in general the students' work is from the raw material to the finished product sold. They are paid for this shop work on a scale of wages which begins at ten cents per hour and increases at the rate of one cent per hour every six months, making the total earnings of the course about $1800.

The course is six years long, and is just as thorough, broad, and cultural as the four-year course and has the same entrance requirements. Applicants for positions in this work are required to enter the shops about the first of July preceding their entrance to the university and must satisfy the shop owners as to their integrity, zeal, stamina, and adaptability before they will be accepted by the university in the fall. This, briefly, is the coöperative plan.

Success in the Shops

When the course was begun two years ago, about thirty manufacturers agreed to make the experiment. At the present time there is only one shop of any size in the city of Cincinnati and vicinity which will not gladly accept these student-apprentices. The plan has worked with the utmost smoothness in all the coöperating shops except one. This shop has its main office in another city, and during the two years of the coöperation there have been three changes in the management of the local shop. For this reason the coöperation has not been as frictionless as desired. With this exception, however, manufacturers are entirely satisfied that the system is a thorough success. The course was started at a period of high prosperity and has worked smoothly during the depression. No students have been thrown out of work, even temporarily, but on the contrary, the manufacturers are asking us for additional men for next year.

The coöperation of the employers, contrary to many predictions, has been cordial, intelligent, and far-sighted. The supremacy of Cincinnati in the manufacture of certain kinds of machinery is not astonishing, in view of the character of the men who have organized and who manage its shops. The writer is of the opinion that a more progressive or broader-minded set of manufacturers cannot be found.

The first year the course was put into operation, about sixty young men came to the university to inquire concerning it. Of these forty-five went into the shops, and when the university opened in the fall twenty-eight were left. The second year there were eight hundred inquiries and applications; from these sixty were selected and sent into the shops, and when the college opened in September forty-four were recommended to us and started their university work. This year the applications and inquiries approximate two thousand; from this number we expect to select less than one hundred men, and, judging from last year's experience, about two-thirds of these will begin the course in the fall.

The Ideas of Applicants

It will be evident that the selection from this large number is one of the most serious and important problems which we have to meet, and the work of selection has opened our eyes to some features of engineering education which we believe will be interesting and instructive to the teaching profession. Seventy-five per cent. of the applicants are from young men who desire to become electrical engineers. As far as possible, every prospective student is personally interviewed, and upon his statement that he desires to become an electrical engineer, he is immediately asked, why? The answers usually indicate that the student has one of two ideas: First, he has read that this is the electrical age and that a man in order to acquire money in the future must be an electrical engineer. His impression is that an electrical engineer is one who does spectacular things. He has what we have come to call the "dazzle idea;" his conception seems to be that electrical engineering is a series of bizarre "stunts." As to the hard and tedious problems which confront the electrical engineer, he has absolutely no ideas. The second class are those who think that electrical engineering is wiring a house. It is astonishing how many high-school graduates have this conception. In the interviews the real object of the electrical engineer's career is pointed out to the young man and he is told what the six years' coöperative course means in hard and laborious shop work. Many of the applicants, of course, withdraw when they learn that electrical engineering is not a pyrotechnic display, or when they are told that they can learn how to wire a house in six weeks at a night school. A considerable number also surrender to mental cowardice in the matter of dirty work, long hours, and shop discipline. If we can get one good man, sound mentally, sound physically, and temperamentally adapted to the profession, out of twenty-five applicants, we consider that we are doing fairly well. Yet this is the material which enters our engineering schools, with the same distorted ideas; and so far as the writer knows, our colleges do not tell them what electrical engineering really means. I venture the assertion that if a thorough canvass were made of freshman electrical engineers, the majority of them would be found to have the "dazzle idea."

In mechanical engineering applicants seem to have a better grasp of what the words mean, and we get one good man in about ten. In chemical engineering the same fairly good knowledge of the intent of the course is shown.

Selecting the Students

In selecting a student the question in the mind of the writer has always been: "Is this young man before me the kind of a man on whom the university should spend about $1600?" This brings up, as you see, the whole problem of the economics of engineering education. The scope of this paper will not permit as thorough a discussion of this subject as it should have, but the essential ideas will be outlined. It costs any self-respecting institution about $2000 for every student it graduates. The student pays to the school from $200 to $1000 for his instruction. The school, therefore, expends on the student anywhere from $1000 to $1800. This money is obtained either from endowments or from taxes. In either case it is a public trust, held by the trustees of

*A paper read at the Detroit meeting of the Society for the Promotion of Engineering Education.

†Dean, College of Engineering University of Cincinnati

the school, to be used by the faculty for the benefit of the public through the education of young men. If we are going to spend from $1000 to $1800 on every graduate, is it not a reasonable business proposition to select the men on whom the money is to be expended?

The criterion which we have adopted may be stated as follows: Only those men should receive a higher education who would in all probability be successful without it, and this is really the basis of our selection as far as human judgment and careful observation can make it. There is nothing more helpless than the educated "mollycoddle," and there is nothing in all our educational system so wasteful as the present scheme whereby any young man who has the money and enough brains merely to get through certain mental work is given training, which is denied to a young man of much superior general ability, but with a lack of funds. Parenthetically it may be stated here that a large proportion of the failures in the course have been city-bred boys; country boys as a rule "make good." As a matter of fact, some of our largest concerns will not accept city-bred boys in the future.

Economy of the Plan

There is no additional expense in the coöperative system by reason of the alternation except in the lecture courses, for all classes must be sub-divided into sections of about twenty men each, and it does not matter whether the first section is taught this week and the second next, or whether the first is taught at 10:30 and the second at 11:30 o'clock today. The lectures, of course, must be repeated, but the preparation for the lecture is the same.

There is, however, a large measure of economy in the coöperative course by reason of the fact that the university is not required to equip, maintain, and supervise practice shops. The manufacturing shops of Cincinnati are the practice shops of the university, and the student, instead of paying us for instruction, receives much superior training in the factories and is paid for his work. Engineering laboratories can be cut down in equipment to a certain extent without any loss in efficiency, for the testing rooms and engine rooms of the commercial shops become, in a measure, our engineering laboratories.

Records of the Students

It is hard to make an accurate determination of the relative efficiency of instruction in the four-year and the coöperative courses. The records in one or two subjects, however, will indicate about what this would be. In calculus, for instance, not one of the coöperative students failed. The lowest grade received by any coöperative student was 73 (60 being the passing grade and 100 the maximum), and 50 per cent. of the class received over 90. In the regular four-year engineering course, on the contrary, about 20 per cent. of our students failed in calculus and few received a grade above 90. In this connection the fact should be noted that the examination given to coöperative students was harder than that given to regular students. In chemistry the coöperative students and the regular students have the same examination, answering exactly the same questions. Ninety per cent. of the coöperative students passed and about 80 per cent. of the regular students. This need not be astonishing, for, with few exceptions, the coöperative course is not carrying any dead wood. It will be seen, therefore, that since the efficiency of the instructor depends primarily upon the amount of actual substance absorbed by the class, it is increased very considerably in the coöperative courses.

Changes in the Plan of Instruction

When this system was started two years ago many questions of detail arose. For instance, the matter of the rearrangement of the college courses was taken up. It was concluded, however, that the best thing for us to do would be to learn by experience. The university publishes curricula, but it must be definitely understood that these are not exclusive and inflexible. As a matter of fact, they have been changed radically, and since the last publication of them they have undergone further changes. They will continue to be modified for years, for we are happily being driven from traditional methods by the coöperative students themselves. Here is a sample of what happens:

The instructor in mathematics covers the blackboard with the demonstration of a long formula, and when he has finished it he turns to the class and asks, "Do you understand that?" The class replies that it does, but inquires seriously, "What shall we do with it?" This has happened a number of times, and at first caused much annoyance to the instructor; but when it was pointed out to him that if a thing had no use it was useless and should not be taught in an engineering college, light dawned on him, and he now spends much of his time hunting practical exemplifications of theory. This is the characteristic attitude of the coöperative student, and it is not surprising. Our four-year students are accustomed to being handed a formula which they hold until examination time, when they hand it back. The coöperative student in the shop is handed a tool and is instructed how to use it. He uses it, hands it back to the tool room, and thereafter knows where to find the tool and how to use it. When he is handed a formula or a theory at the university it is a matter of second nature to him to expect to be shown how to use that formula or theory prior to his handing it back. Thereafter, as with the tool, he knows where to find it and how to use it.

We have inaugurated what we call the "reverse quiz" in class. Toward the end of the hour students are given permission to ask any questions that have a bearing upon the subject, and this has been perhaps the most valuable addition to our system. It is, of course, uncomfortable for a young instructor, but if he is the kind of a teacher our engineering college ought to have, he will work to meet the situation. If he is not, there is only one thing for him to do. The shop knowledge of the student has demonstrated to us the fact that some of the instruction in our colleges is not only frequently out of date, but also that it is as often absolutely wrong. You will observe that there is a check upon the instructor's work which cannot be had in any other way except through this practical knowledge of the student.

The questions of these young men have caused us to change our courses and will cause many more changes as the work advances. Mathematics, for instance, is taught as one subject, the fundamental principles of university algebra, trigonometry, analytical geometry, and calculus being given during the first part of the freshman year; and thereafter any one formula is derived by the different methods. The course in mechanics is taught as part of the course in calculus. Descriptive geometry and machine drawing will hereafter be given as one subject, because when a student was given a problem in descriptive geometry he wanted to know its application, and when told the application, wanted to know whether he could not put it at once on the same sheet.

The alternating periods were fixed at one week tentatively, and this has proven very satisfactory. A vote of the students was recently taken, and they were unanimously in favor of the one-week period as giving them the proper alternation of mental and physical work. They also state that absence from the shop for more than a week allows their muscles to become soft, and for this reason they prefer to continue on the week system. The shops also desire to keep this period of one week, because if the period were made longer at the university the student would lose some of his skill by the time he returned to the shop. It has been definitely concluded, however, that when the young men go into the designing and sales offices—which will be about the fifth year—the alternation will be by semesters. It will be impossible for a young man to work in a designing or sales office with any benefit to himself or to the firm for a shorter period than six months. The students in the coöperative course will then enter the regular classes at the university, when a better comparison of the work of the two classes of men can be made.

The Students Heavily Loaded

Since the coöperative student is at the

university for a period of three years, as compared with four years of the regular student, it became evident, of course, that he would be required to do more actual class and laboratory work per week than our regular students. Additional hours were given to him during his alternate week at the university, and the roster was considered by some of our faculty to be too heavy. At the end of the first year, however, the students finished without any seeming effort and with much better records than did our regular students. This year a further experiment was tried by the writer on the freshman coöperative class by giving them work every period of the day from 8:30 until 5 o'clock, with one-half hour for lunch, except on Saturday morning, when they work from 8:30 until 10:30 o'clock. This, it will be seen, is about the heaviest roster the student can possibly carry. At the end of the year the men were more vigorous, mentally and physically, than they were in September. They were more active in university social affairs, ahtletics, and general student life than the regular students, and they had made much better scholastic records. This seems to be a demonstration of the statement that "if you want a thing done, ask the busy man to do it." It is the writer's personal opinion that this class of men could finish all the work that our four-year students have, in a five-year coöperative course; but we shall continue to have a six-year course and shall simply put in such additional subjects as these students are peculiarly equipped to take, and which our regular four-year students cannot take by reason of a lack of practical knowledge.

Other Fields for the System

At the University of Cincinnati there is no coöperative course in civil engineering, because the local conditions will not permit. There could be one, for instance, at Pittsburg, in connection with the American Bridge Company and the railroad lines centering in that city The Pittsburg school could have also coöperative courses in mechanical, electrical and metallurgical engineering. At Philadelphia there could be courses in marine engineering and naval architecture as well as in mechanical engineering. The plan contemplates that the school shall have coöperative courses in all those departments which have a sufficient number of industries to make the operation of the course possible. The details will be matters of compromise, as they are with us at the present time. An Eastern engineering school about to install this system with a large manufacturing plant in its vicinity contemplates having a two- or three-week alternation system, with gradually increasing periods to graduation, the last year of the course to be spent in school.

An English Milling Machine with Independent Belt Feed

By I. W. Chubb

In arranging for independent cutter, spindle and feed drives in connection with milling machines the chief danger has of course been that the feed might continue in operation while the cutter spindle itself was stopped. To prevent this Parkinson & Sons, Shipley, England, are introducing a governor device which controls the position of the feed belt. The arrangement is shown in Figs. 1, 2 and 3.

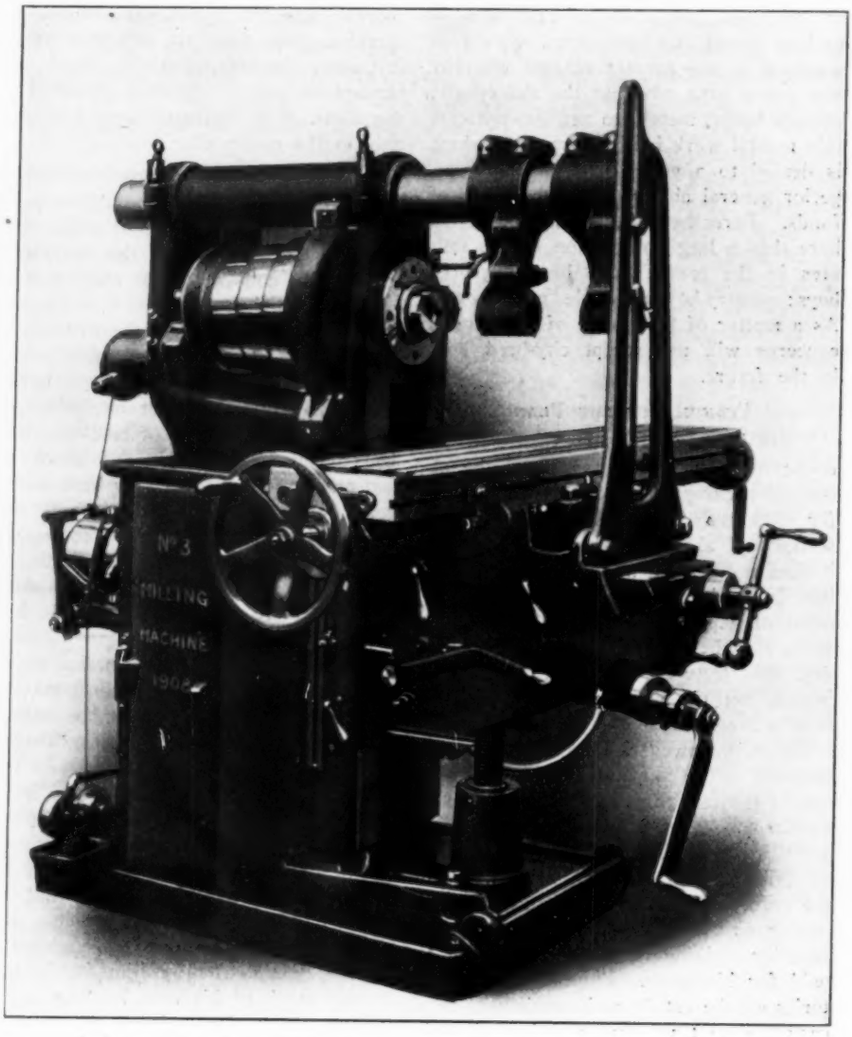


FIG. 1. SIDE VIEW OF ENGLISH MILLING MACHINE

Feed Box

On the feed box are mounted a tight and a loose pulley with a belt fork. The drive may be from a countershaft or even from the lineshaft and the belt obviously runs at constant speed and always in the same direction. Above this box is a casing, bolted to the machine and containing a shaft driven from the cutter spindle. Here a governor of the Pickering type is mounted. Each governor ball is on a thin steel strip, one end of which is secured to a fixed collar on the spindle and the other to a sliding collar. The position of the latter depends, of course, on the position of the balls and therefore on the speed of the cutter spindle. This sliding collar is grooved so that a lever engages with it. On the same pin is another lever connected by chain to a catch or hook. If the spindle runs faster than the lowest-rated speed, the chain is slack and the hook can engage with a projection on the belt-fork spindle, thus holding the belt on the tight pulley. But if the speed of the cutter spindle falls below the predetermined limit, the governor operates to tighten the chain and raise the catch clear of the belt-fork spindle, thus releasing the fork and allowing it to be drawn over by a spring to the loose pulley. When the machine is at rest, the feed belt is of course always on this pulley. It is moved to the driving position by the operator who presses on a pedal bar at the front of the machine and it is maintained in this position by the catch.

Gear Box

A view of the gear box is given in Fig.

4, this box being bolted to the rear of the column. The speed changes are effected simply by turning the handwheel seen in Fig. 3 and setting the levers below to positions indicated on a plate. The motion is transmitted from the box by the telescopic shaft and universal joints at the side to the knee. Thus while damage to the machine and work is prevented, any feed can be used with any cutter speed and the power supplied both to the cutter and to the feed may be properly determined.

Details of Construction

In the machine illustrated the working surface of the table is 53x12 inches, the feeds being 36 inches longitudinally, 10 inches transversely, and 20 inches vertically. The total power supplied is calculated at about 6 horse-power, 1⅓ horse-power being apportioned to the feed and 4⅔ horse-power to the cutter spindle. The weight of the machine is about 4250 pounds. For driving, a three-speed cone is used with steps from 13 to 10.6 inches diameter, for a 3½-inch belt, and the gear ratios are 3.28 and 11.2 to 1. With a two-speed countershaft, 18 spindle speeds are available, ranging from 13 to 400 revolutions per minute. The feeds range in 16 steps from ½ inch to 14¾ inches a minute, the speed of the feed pulley being 210 revolutions per minute.

Spindle Arrangement

The spindle has a front bearing 3¼x4⅞ inches and a rear bearing 2⅛x4⅛ inches. It is bored No. 11 Brown & Sharpe taper, provided with a cross slot, and mandrels are drawn in by a long bolt and withdrawn by nuts on their collars. The overhanging arm is 4½ inches diameter and the largest diameter of cutter that can be used with the arm in position is 14¾ inches. In the case of the universal machines the headstocks will swing 12 inches diameter and admit 3 feet between centers, the dividing spindle hole passing 2 inches. One point in the construction is that no opening is made at the front of the hollow column. The box section is maintained and internal ribs are also supplied, while a cupboard is fitted outside.

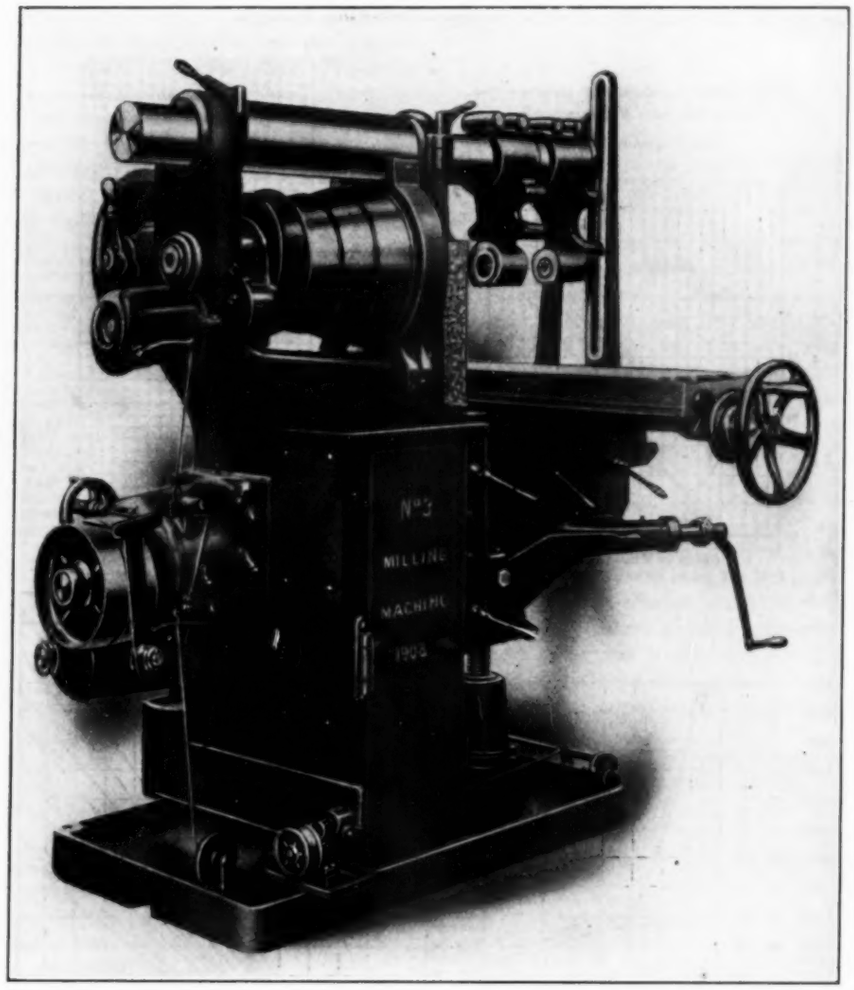


FIG. 2. SIDE AND REAR VIEW OF ENGLISH MILLING MACHINE

Among the many mechanical improvements introduced of late years into the glass-making industry a recent improvement in the handling of large sheets of plate glass is quite important. It is accomplished by the use of heavy electric magnets placed against the glass on one side while on the other are flat plates of iron or steel. The magnet holds the plate tight to the glass, thus enabling a heavy plate of glass to be handled with ease by the use of as many magnets as are required to exert the necessary power. Each magnet is connected with the current producer by wire so that the plate-glass sheets can be deposited at any desired points by cutting off the current in exactly the same manner as the lifting magnets for iron and steel products are handled.

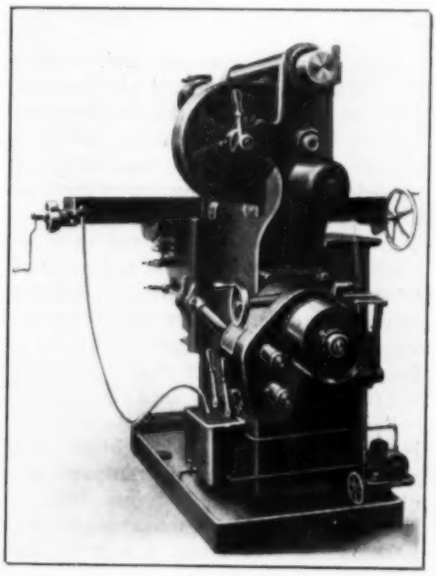


FIG. 3. REAR VIEW OF ENGLISH MILLING MACHINE

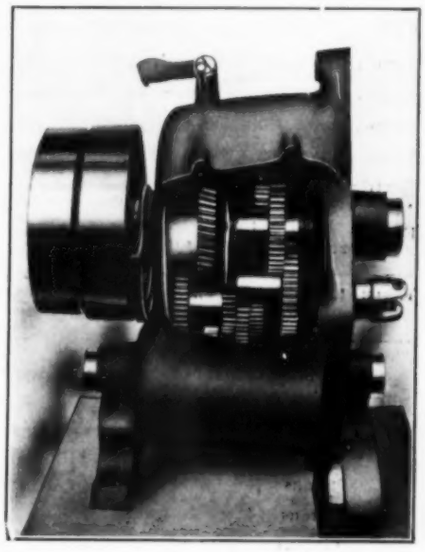


FIG. 4. MILLING-MACHINE GEAR BOX

Bessemer steel-rail production in the United States during the year 1907 ran to 3,302,000 tons, which was a slight reduction from the previous year's figure.

Power Calculations for Electric Vehicles

The Results of Many Tests Give Simple Charts and Constants for Tractive Effort, Weight, Transmission, Tires, Road Surface and Grades

BY W. J. AITKEN

Many articles have been written from time to time on the method of calculating the gear reductions of the electric-power vehicle, but in all of them some point remained unexplained or entirely disregarded, thereby creating an uncertainty in the mind of the designer or engineer. This article has been prepared from the results of over 150 different tests of electric-power vehicles on different road surfaces, with different tires and under different conditions of weather. As far as possible any data other than that resulting from such tests has been eliminated.

Before proceeding with these results it is necessary to have an idea of the total weights and speeds of different capacities of vehicles, and since it is impossible to build all bodies alike, a mean weight of at least 15 different types of vehicles has been taken. See Table 1.

Carrying Capacity.	Total Weight in Pounds.	Weight Front in Pounds.	Weight Rear in Pounds.	Battery.
1,000 pounds	3,660	1,680	1,980	44 cells— 9 plate
1 ton.....	4,900	2,300	2,600	44 cells—11 plate
2 tons	6,840	3,244	3,596	44 cells—13 plate
3 tons	8,000	4,000	4,000	44 cells—15 plate
4 tons	9,000	4,200	4,800	44 cells—15 plate
5 tons	10,000	4,800	5,200	44 cells—17 plate
Electric Victoria...	1,925	813	1,112	30 cells— 9 plate
Electric Roadster..	2,415	1,364	1,051	62 cells Edison.

TABLE 1. CARRYING CAPACITY, WEIGHT AND BATTERY FOR ELECTRIC POWER VEHICLES

Practical speeds representative of general practice are as shown in Table 2.

Capacity.	Speed in miles per hour.
1000 pounds	12
1 ton	10
2 tons	8
3 tons	7
4 tons	7
5 tons	6
Victoria	15
Roadster	18

TABLE 2. SPEEDS OF ELECTRIC VEHICLES.

TRACTIVE EFFORT

It is now necessary to determine the "Tractive Effort" or "Draw Bar Pull" of the vehicle. This tractive effort is the push which must be exerted at the rim of the wheel to propel the vehicle and is dependent on the speed in miles per hour, efficiency of transmission, tire friction, road surface, gradient and wind resistance.

Fig. 1 is the tractive effort in pounds per ton at various speeds, based on hard, level asphalt, 100 per cent. efficiency of transmission, Firestone tires and includes wind resistance.

Thus for a 1000-pound vehicle, running at 12 miles per hour, the tractive effort as shown in Fig. 1 is 27 pounds per ton and assuming a transmission loss of 20 per cent. of the tractive effort this would be $27 + 5.4 = 32.4$ pounds per ton.

Having found the correct tractive effort corresponding with the design of vehicle it remains to find out how the gearing must be proportioned to transmit the necessary power and the ratio of speed and torque in the motor.

The brake horse-power required by the motor or motors is determined by the following formula.

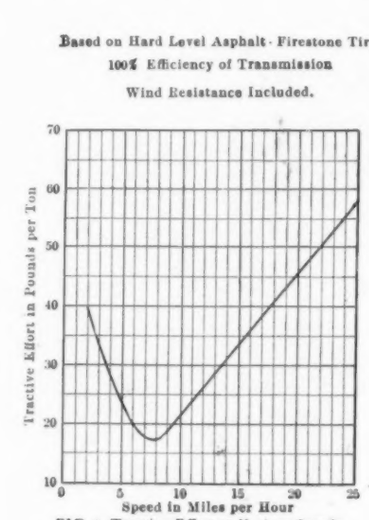

Based on Hard Level Asphalt · Firestone Tires.
100% Efficiency of Transmission
Wind Resistance Included.
Tractive Effort in Pounds per Ton
Speed in Miles per Hour

FIG. 1. Tractive Effort at Various Speeds.

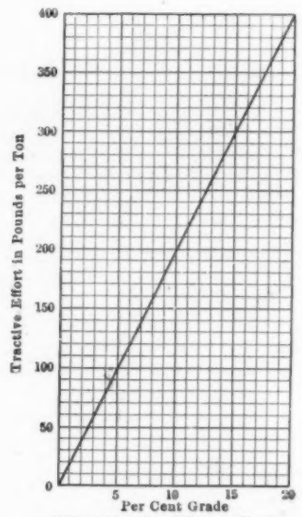


FIG. 2. Tractive Effort on Grades.

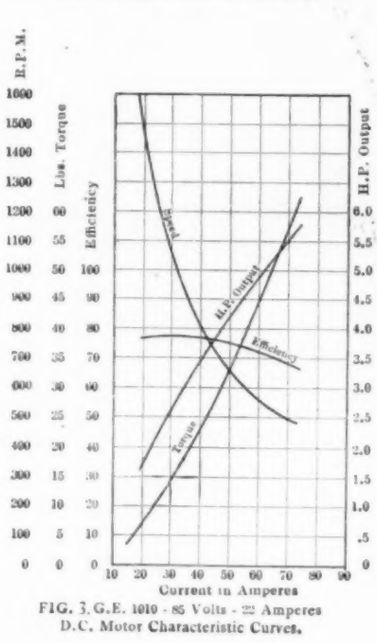


FIG. 3. G.E. 1010 - 85 Volts - 22 Amperes D.C. Motor Characteristic Curves.

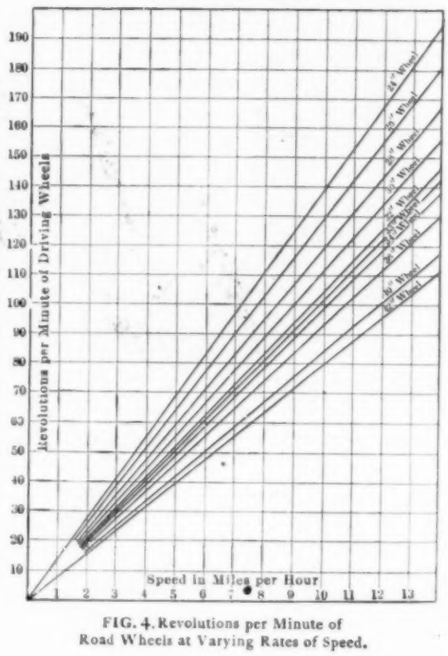


FIG. 4. Revolutions per Minute of Road Wheels at Varying Rates of Speed.

Let S = speed in miles per hour,

W = weight in tons and

T = tractive effort in pounds per ton.

Then *horse-power* $= 0.0026\ S\ W\ T$.

Motor Characteristics

In the present condition of the automobile industry it is unnecessary to design a motor to fit a special running gear as it is possible to obtain a standard motor to fill all requirements. Thus, in Fig. 3 is shown the characteristic curves of a standard motor. Assuming the above formula to be applied to the 1000-pound vehicle before mentioned, it becomes:

Horse-power = 0.0026 × 12 *miles per hour* × 2.33 *tons* (vehicle weight + load) × 32.4 *pounds per ton* = 2.36 *horse-power.*

Referring to the curves, we find that our motor at 2.36 horse-power draws 27 amperes at 1160 revolutions per minute and develops 11 pounds torque. The revolutions per minute for 32-inch wheels at 12 miles per hour, can be found by referring to the chart, Fig. 4, which shows a speed of 126 revolutions per minute. To this it is necessary to add 5 per cent. for slip and flattening of tires which makes a total of 132 revolutions per minute in round numbers. The 1160 revolutions per minute of the motor ÷ 132 revolutions per minute of the wheels will equal 8.78 to 1, the total reduction. This is ordinarily too large for a single reduction, therefore it must be divided into two convenient factors.

Source of Loss of Power.	Amount of Loss in per cent.	Efficiency in per cent.
1-bearing (plain)	2½	97½
1-bearing (Timken roller)	¼	99¾
1-bearing (annular ball)	¼	99¾
1-Universal joint	5	95
1-roller chain	6	94
1-silent chain (horizontal)	3	97
1-silent chain (vertical)	5	95
1-set spur gears (steel greased)	10	90
1-set spur gears (steel pinion fiber gear)	12	88
1-set spur gears (leather pinion, C. I. gear)	12	88
1-set spur gears (steel oil bath)	8	92
1-set bevel gears (steel oil bath)	12	88

The above efficiencies are the results of tests on *new* bearings, chains, etc. If results are necessary for *old* bearings, etc., add 50 per cent. to the given loss.

Table 3. Loss in Efficiency Due to Friction, etc.

It will be noticed that the calculations are entirely mechanical. This is for the reason that the electrical method of calculating is based on the watts per ton-mile power consumption. This method is reliable because any binding or imperfect adjustment will change the result. It is also possible with this method to use the data for gasolene automobiles.

Transmission Losses

From Table 3 can be obtained the loss in efficiency of practically any type of transmission. Thus, suppose it is necessary to find the loss in the transmission shown, a single reduction, roller chain drive with live axle running on Timken roller bearings.

One roller chain = 6 per cent. loss; four roller bearings at ¼ per cent. loss each = 1 per cent. loss; total 7 per cent., or 93 per cent. efficiency.

The motor must make up this transmission loss, therefore to obtain the tractive effort for the above machine it would

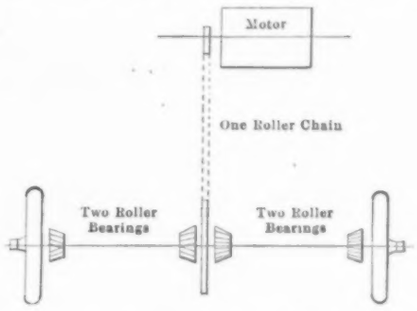


FIG. 5. A SPECIMEN TRANSMISSION

be necessary to take the reading from the chart, Fig. 1, and add 7 per cent. more to cover the losses.

Since it is necessary to supply different makes of tires for vehicles, Tables 4 and 5 have been prepared. Chart, Fig. 1, is based on Firestone tires and hard, level asphalt. The tractive effort for the given speed is found from chart, Fig. 1; added to this is the loss for transmission and this product is multiplied by the tire coefficient or road coefficient as the case requires.

The chart, Fig. 2, is the *additional* tractive effort required for hills and should be added to the tractive effort for level running. Thus, if the 1000-pound vehicle before mentioned must climb a grade of 10 per cent. which is shown on the chart to be 200 pounds per ton, the total tractive effort would have been 32.4 pounds + 200 pounds = 232.4 pounds per ton.

It is possible from this data to find the performance of any style of electric vehicle, on any tire, road surface and grade. In deciding upon a motor for a vehicle it is necessary to first find the gear reduction for level road surface, and then find the necessary power under adverse conditions, such as sand road or heavy hill climbing.

Make of Tire.	Coefficient.
Firestone	1.0
Durr block	1.0
Gibney	0.92
Diamond	1.30
Hartford	1.35
Kelley-Springfield	0.95

Table 4. Tire Comparison.

Road Surface.	Coefficient.
Hard level asphalt	1.0
Wood pavement	1.15
Macadam	1.22
Cobblestones	1.72
Sand	2.00

Table 5. Road Comparison.

By comparing these results with several motor curves it will be possible to obtain a comparison between the various motors, and select a motor best adapted for the service.

The chart, Fig. 6, is for speeds of vehicles above 15 miles per hour.

Summary

In figuring a gear reduction first find the tractive effort, making correction for transmission, tires, road surface and grades.

Then the horse-power = 0.0026 $S W T$, where

S = speed in miles per hour,

W = weight in tons and

T = tractive effort in pounds per ton.

Then find speed of motor corresponding with horse-power; then speed of wheels and add 5 per cent. for slip and flattening of the tires. The motor speed divided by wheel speed equals total gear reduction.

Before deciding upon a motor it is necessary to consider the vehicle as operating under *best* conditions and then under *adverse* conditions. If the motor is not correct for *both* cases it will not be satisfactory.

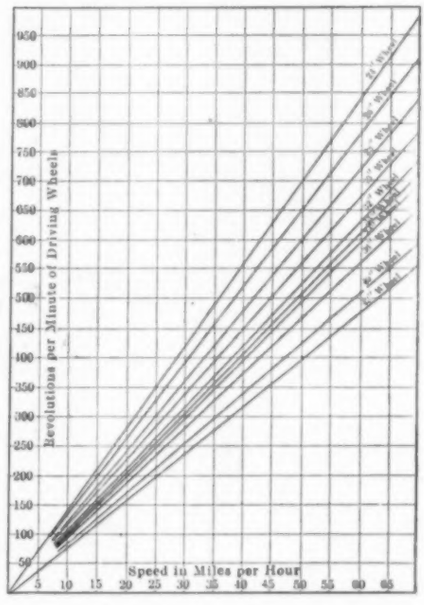


FIG. 6. REVOLUTIONS PER MINUTE OF ROAD WHEELS AT VARYING RATES OF SPEED

Figures recently completed by the Geological Survey show that during the year 1907 there was consumed in the United States 17,211,000 pounds of aluminum. While the increase in the use of this metal was not as great as was predicted last year, the increased consumption over 1906 amounts to 2,301,000 pounds.

Reports from what seem to be official sources indicate that a treaty with Japan will soon be placed in force by which American patents, trade-marks and copyrights will receive full protection in Japan and thus do away with the flagrant appropriations of ideas that are bound to take place where no agreement is in effect.

An Electrically Driven Burring Machine

By A. J. Doughty*

As the parts of the Burroughs adding machine are small and are made in large numbers, it was necessary as one step in the process of manufacture to provide rapid and economical means of burring them. This was accomplished by developing an electrically driven burring machine shown by Fig. 1. It consists of a small motor, which can be run in a vertical, horizontal or inclined position, having an extension of the armature shaft carrying a chuck. In this chuck are held burring dies, a variety of which are shown by Fig. 2. They are small rotary files and are adapted for the work on which they are to be used, as a study of their shapes will show.

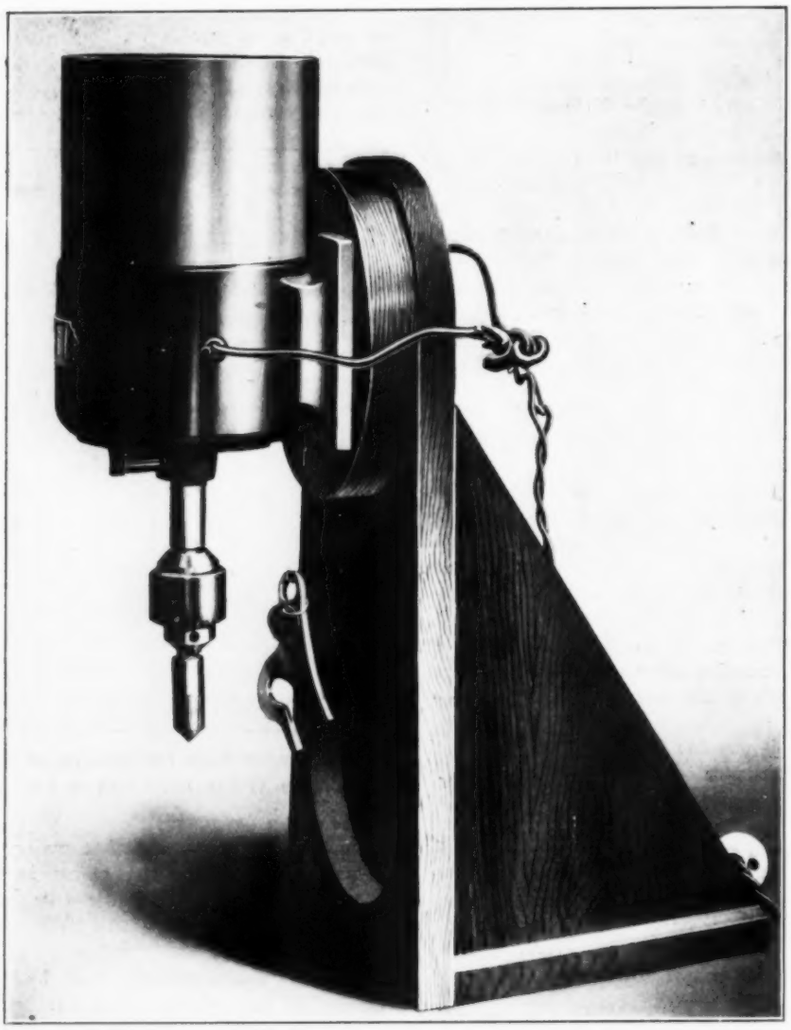


FIG. 1. AN ELECTRICALLY DRIVEN BURRING MACHINE

Fig. 3 shows the burring department. Machines will be noticed in various positions depending upon the kind of work to be done. This department employs girls, exclusively.

*Factory manager, Burroughs Adding Machine Company.

Echoes from the Oil Country—The Salesman and the Manager

By W. Osborne

A number of drummers were gathered together at the hotel, and after the usual manner of the craft, they were swapping experiences, and occasionally poking fun at one another. Even a lack of success seemed to have its uses for the telling of it often seemed to be very amusing to the others, and much talking has given most of them the art of being able to tell a thing in an interesting way even if the tale is one of discomfort as applied to the teller.

"Say, Eddie, did you have to hire a dray to help you carry the order you got from your friend up at the big works? If you get a few more friends like that you won't have to come out any more." The laugh that followed this sally showed that it was a "dig" of some kind.

"Where is the fun in this. Put me next, someone. I haven't been in this district very long."

"I should say you hadn't been coming through very long if Eddie has never told you of his friend. He's that proud of him that he tells everybody. Knew him when he was just a common machinist. Saw him begin to grow and get up. Boosted him whenever he could, and now that friend is at the head of the biggest thing in this section. Eddie is a modest, retiring sort of fellow, and now he has to slip into town on the quiet like for fear that he will be met with an automobile and a brass band and so swamped with orders that he will be overworked writing them down." This seemed very amusing to most of the "boys," but several of them seemed to be in the dark.

"Just get Eddie to tell you all about it. There is nothing that he would rather do. He is like some of the ladies when you ask them to sing. He has to be coaxed a bit, but he will feel bad if he doesn't tell it."

The man whom they called Eddie saw that the easiest way out was to tell his story for the benefit of those that had not heard it.

Getting Swelled Up

"I'll give an outline of it. It spoils my appetite to go into details. When Charley Crab was a machinist and I was new on the road we were well acquainted, and he was glad to get all the pointers that I could give him. He was smart and I used to tell him that he was a dunce for staying at the bottom. When they needed a foreman at the old Witherlow place I told them about him and him about them. This was his first bossing job. He didn't stay there very long, but after moving around some he got in with the people he is now with and has been working up until he is the mechanical head of the place, and if you want to get in to see him you had better take a kit of burglar tools along. When he was foreman he was tickled to death to see any of us. When he got to be superintendent he would spend hours with us and pump us for all kinds of information. Now a boy takes your card and leaves you sitting out in the entry. In about an hour he comes back and tells you that Mr. Crab is busy, or to go to the other office and see the purchasing agent, or to call again in about two days, or that they are not in the market at present. If you go to the purchasing agent he tells you that he has no requisitions in for the goods you handle, and that you had better go to the works if you expect to sell goods. The rest of the boys get the same kind of a deal that I do, and they are all sore. They take it out on me because Charley and I are friends, or used to be."

Following this several other of the boys told of troubles had in trying to get the ear of the man in authority. I was a friend of Charley's also, and had stopped

over on my way east to see him. After hearing these stories I began to think that perhaps it was a waste of time on my part.

The next morning I stood in the entry and handed my card to the boy.

Several of the ones who were at the hotel the night before were there ahead of me, and two came while I was there. In a few minutes the boy returned and admitted me and I was taken into the private office.

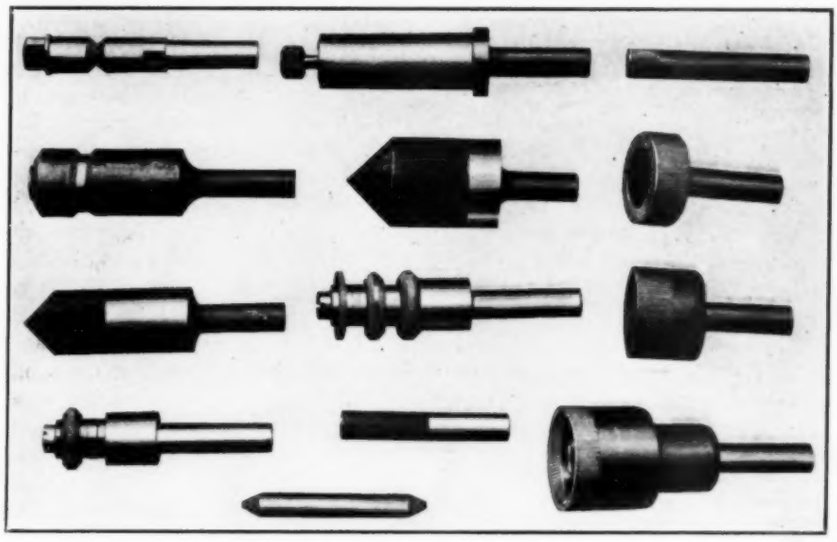


FIG. 2. DIES OR BURS FOR THE ELECTRICALLY DRIVEN BURRING MACHINE

Depends Who Calls

Charley received me very cordially, and after the usual expressions of good will insisted that I should spend at least part of the day with him.

I knew that he must be a very busy man and said as much.

"That is all right. If you can amuse yourself with the papers for a little while I will arrange things so that it will be all right. It is not very often that I get a chance to visit with an old friend like you. Most of my callers have something to sell, and every last man of them knows that his goods are the only ones fit to use. If he hasn't something to sell the caller will have a new system of shop management or something of that kind and want you to turn the place over while he shows you what a wonderful thing it is."

I watched with interest while Charley looked over sheets of reports, files of orders, and a stack of letters. While busy with this he had a number of talks over the 'phone which was on his desk. Several times the office boy had appeared with cards and had received directions concerning the owners. Other boys had appeared, who, judging from their appearance, brought notes from the departments of the works. Some of these notes were answered in writing and sometimes the 'phone was used. Twice Charley went to the door and talked shop to someone there.

I began to feel that I was intruding and that it was an imposition for a man who had no business to present to call on a man who had so much to do, and was trying to think of some excuse whereby I might get out gracefully when Charley sent the office boy out with a stack of the papers which he had on his desk and turned to me. "Now we won't be bothered unless something important comes up in the works, or some man that I will have to see sends in his card. Do you know, this salesman business is one

FIG. 3. THE BURRING DEPARTMENT OF THE BURROUGHS ADDING MACHINE COMPANY

of the hardest things to handle that I have had?"

As this was a subject in which I was interested, I did my best to draw him out and get his side of the subject.

LOOKING FROM THE MANAGER'S SIDE OF IT

"I appreciate the value of a good salesman, and the necessity for him, and I believe that he should be given attention when he calls. If his line of goods are not of interest he should be so informed, and if they are he should be allowed to see the man who has it in hand to judge of their suitability. I have had salesmen complain to me because they called and did not get to see me, but were perhaps taken to a shop man who had on overalls and whose face and hands were covered with shop dirt. They knew that that man could not give them any order or allow them to send anything on approval, and sometimes they would not spend much time with him. Some of them would use what little time they did spend in kicking about the way I had swelled up since I got to be general manager. If any of their goods went into the shop it would be used under the charge of this very man, and it would be up to him to show that his judgment was good in wanting them.

"Results are what we are after, and a man gets better results from a thing which his judgment has prompted to ask for than he does from something which he thinks is not suitable for his conditions. Of course, there are lots of things used around a works with which it is only a matter of getting the best quality for the lowest price. The purchasing agent can handle them without the shop being bothered.

"Lots of these salesmen are so wrapped up in the importance of their own job that they never think of anything else. At first I used to make it a point to see every man who insisted on seeing me, and this is how it would often work. The office boy would bring me a card that did not tell me much when I was out in the far shop planning some changes with one of the foremen. I would drop everything and hurry to the general office to find a man whose aim in life was to convince me that it would be much better to use rags than waste in keeping the machinery clean. The only way to get him stopped would be to either walk off and leave him or get someone to show him the door. At another time the office boy would not be able to find me and the telephones would be used to each department. After everybody was stirred up without locating me the power-whistle call would be blown as a last resort. I was on the roof inspecting some skylights and trying to decide whether they could be repaired or whether it would be necessary to put in new frames, and that was why neither office boy nor telephone calls reached me. When I get down in haste, alarmed for fear of some disaster which may have overtaken either man or machinery, I find a man who wants to sell me tailor-made shirts. He claims to supply the president of the company and says that the president asked him as a favor to come and take my order for some."

I burst out laughing at the picture that came to my mind of a man hurrying down a long ladder filled with dread for fear of calamity to his men and then being met with such a plea. I could imagine the reception which he would get from most of us. Charley laughed too.

"It is all right to laugh now, but when it is piled on thick enough it soon gets so that it is not a laughing matter. Most men do not get the positions of managers because they are Chesterfields in their deportment. They must get out work.

GETTING IN BY SENDING STUFF ON TRIAL

"There is another kind of a salesman who is often a nuisance and he is the fellow who insists on sending in his stuff on trial whether you ask him to or not. Sometimes you are willing to order something new and try it enough to know whether it suits your needs or not, but that does not mean that you are going to turn the whole shop into a testing laboratory. You don't think it is so bad as I picture? Let me show you something." Charley took a paper out of one of the pigeon holes of his desk.

"Of course, most manufacturers are willing to have their goods tested alongside of other goods if the other goods have not been giving entire satisfaction and there is likelihood of a change, and many salesmen take advantage of this willingness to try to force their goods in. Even though you pay for the goods and use them you are deluged with all sorts of follow-up letters if you do not continue to use them, and if you do, the man who has lost your business wants to know why and to be given another chance.

"Here is a list which shows that among the salesmen who call with some regularity are the following: Selling belting, 12; emery wheels, 9; iron and soft steel, 5; tool steels, 20; paint, 9; tool holders, 6; electrical apparatus, 13; babbitt metals, bronzes, etc., 16; machinery, 15; wrenches, 8; drills, 7; files, 3; cutting compound, 3; stencils, 2; general supplies, 14. There is 142, and I have not given you the number of those who sell reamers, hack-saws, waste, brooms, oils, tubing, rubber goods, bearings, shafting, surgical supplies, or specialties.

"Add to these the number of those who sell pig iron, coke, sand, molding machines, and foundry machinery and supplies; of those who want to supply the needs of your pattern shop, and of your blacksmith shop, and of your tin shop, and of your office. Then put down the number of those who wish to supply you with expert advice of various kinds, who want a portion of your advertising, or of your insurance, and then think of the irregular, but always large number who want to bless you one way or another on general principles. When you get the whole army marshalled and realize how much in earnest they all are, can you wonder that a man of experience keeps under cover as much as he can?

"I don't want you to think from this that I don't like to have my friends call, for I do. It was your pumping that got this out of me. It rests me to have a friend who is in the business call, but it makes me awfully tired to have a man who never saw the inside of the works, or worked a day at the business in his life, come around and tell me how I should do things."

The same thing has made some of the rest of us tired, too.

In a discussion at the recent conference for the conservation of natural resources it was pointed out that a close estimate showed that the actual mechanical horsepower used for all purposes in the United States does not equal more than 10,000,000 horse-power during maximum demand and it was also estimated that the undeveloped water powers would give approximately 30,000,000 horse-power. To make this enormous supply available where wanted, electric transmission of power can be successfully and commercially used at present up to a distance of over 200 miles, and there is every prospect that this distance will be in the near future greatly increased.

The use of electricity in Japan is being extended in various directions. As a result of this, the Furukawa Company has established a new factory at Nikko for the manufacture of copper wire. During the last year the production from these works has greatly increased. It is principally used for cables in Tokyo and Yokohama, though that employed on the municipal networks was made abroad. The Japanese government has ordered for the port of Yokohama sixty-one electric cranes, varying in capacity from 1 to 75 tons. There are at present one hundred hydro-electric stations at work, and several are in course of construction. Among the latter is one on the river Tamagawa, supplying Tokyo; from this station 20,000 kilowatts are transmitted at 40,000 volts. There is also one of 32,000 kilowatts in course of erection.—*The Engineer.*

A Speed-changing Mechanism without Gears

By H. M. Russell, Jr.

The differential movement here shown is novel in that it produces without toothed gearing the same movements that are produced by the equalizing gear of a motor vehicle.

Fig. 1 shows an elementary form of the device partly in section, and clearly illustrates the principle of the mechanism. A cage or housing made up of opposite halves 1 and 2, held together by bolts which also hold in place the sprocket 11, has bearings at opposite sides for the shafts of the cranks 5 and 6. The cranks are seen more clearly in Fig. 2. The cage

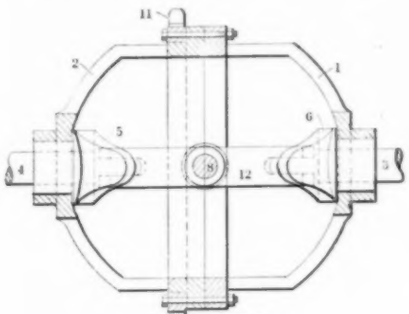


FIG. 1

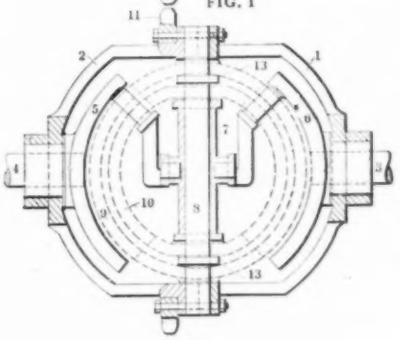


FIG. 2

A NEW SPEED-CHANGING MECHANISM

has a central pin 8 upon which the ring 12 may oscillate. This ring 12 has in its sides slots whose centers lie in a plane passing through the center line of the pin 8. The crank-pins of 5 and 6 pass through these slots. The pins of the cranks 5 and 6 are so placed that their center lines pass through the center of the device, that is, through the intersection of the main axis of 5 and 6 with the center line of the pin 8. Since the center planes of the slots also pass through the center of the device, it is plain that the mechanism will be movable and that the crank-pins, if they fit the slot in one position, must fit them in any position which the cranks can occupy. It is also clear since the device is symmetrical that the cranks, if they move at all, must have equal and opposite movements. Assume the cage to be stationary and the crank 6 to turn toward the top of the figure; this will tilt the ring 12 out of its horizontal plane, and the opposite side of the ring 12 will push the crank 5 down through the same angle as that through which the crank 6 has moved, but in the opposite direction. This shows that we have a perfect differential action.

It will be seen that when crank 6 has turned through 90 degrees the crank 5 will have turned 90 degrees in the opposite direction and the cranks will be opposite. In this position the ring 12 is at the limit of its oscillation and can transmit no power. The device is, therefore, on a dead center. This may be overcome by using four cranks and two rings similar to 12, but set at right angles to each other. The simplest means of overcoming the dead center, however, is that shown in Figs. 2, 3, and 4, which illustrate the device in its complete practical form. Only two cranks are employed, but two rings 9 and 10 are used instead of the single ring 12.

Fig. 2 shows the complete device, except that the dotted lines merely indicate the general positions that would be occupied by the rings. Fig. 3 shows a top view of the ring 9, and it will be seen that the slots instead of being parallel to the axis of the oscillation of the ring are turned at an angle of 30 degrees to this axis. The effect of this is to make the dead center come when the cranks are 90 degrees apart instead of when they are opposite. Fig. 4 is a cross-section of both rings 9 and 10, and shows the relative positions of the slots in the two rings. It will be seen that the slots in one ring are placed somewhat like the threads on a double-thread right-handed screw, while those in the other ring are placed like the threads on a left-hand screw. The effect of this is to make the dead centers of the two systems come 90 degrees apart and so to produce continuous rotation. This may be clearly seen by remembering that the dead center occurs when the ring has reached the limit of its oscillation. The different positions of the slots makes this occur at different times with the two rings, and it may be shown that with the slots tilted 30 degrees the dead centers are just 90 degrees apart. The slots have parallel sides and each slot may be cut with a milling machine at a single operation. All the bearings are cylindrical, and no tapered work is required anywhere about the device. In practice bushings would be used on the pins of 5 and 6, and these bushings would have flat sides to give a good bearing against the sides of the slots. The whole device, including the bushings, is assembled and held together firmly with no other fastenings than the bolts shown in the drawings. It will be seen that the cranks 5 and 6 have counter balances. If these are of proper weight the balance of the device will be perfect, since the rings are symmetrical and cannot be out of balance.

Figs. 2, 3, and 4 were made from the working drawings for a 20-horse-power device. With high safety factor this figured out about 10 inches in diameter over all. The advantages of this device over equalizing devices using toothed gears are that there are no teeth going into and out of mesh, but all the connections are permanent and the action is simply a crank action. All the bearing surfaces are large instead of being mere lines as they

FIG. 3

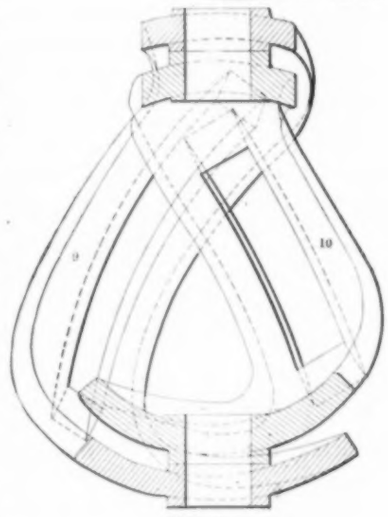


FIG. 4

ARRANGEMENT OF SOME OF THE WORKING PARTS

are with gear teeth. There need be no backlash. Each of the reasons named renders the device less liable to breakage than are the present equalizing gears. And it can readily be made strong enough to carry the brake drum with absolute safety. The action is smooth and absolutely noiseless.

While designed as a balance gear for motor vehicles the movement is capable of various other uses. For example, it could be used as a marine reverse or as a substitute for either the transmission gear or the half-speed gear in an automobile or for both. The device is patented.

Wheeling, W. Va.

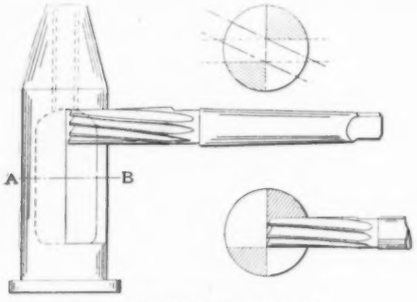
Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Novel Way of Making Slots in Tool Posts

Making the slot in tool posts in the ordinary way is an expensive and not altogether pleasing operation, and I show



NOVEL TOOL-POST SLOTTING

herewith an easier way of making this with an end mill. The illustration shows the end mill at work on one side of the tool post and the sections show how the two cuts meet and form the slot which, on account of its shape, allows quite a swing of the lathe tool in the tool post.

Although the first impression of this form of tool post is that the section through *A B* is weak, it will be found by simple calculation that the tensile strength of that area will be greater than any stress likely to be put upon it by the tool-post screw.

Cincinnati, Ohio. JOSEPH FUCHS.

Reducing the Throw of a Cam

Having some 5/8-inch taps, 26 threads, with 3 cutting edges to relieve in the shortest time possible, we had to find a way to do it without wasting time in pre-

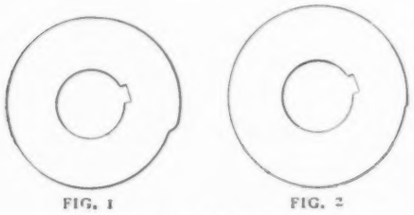


FIG. 1 FIG. 2

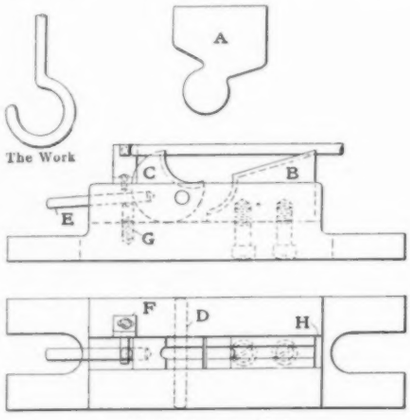
REDUCING THE THROW OF A CAM

liminaries. The smallest cam we had for the relieving lathe had 3 millimeters throw and the new one must have but 1 millimeter. The relieving attachment had a single lobe cam, as in Fig. 1, so we turned a blank of tool steel, geared the spindle to turn three times to one turn of the cam. The tool was set so as to use only one-third of the large cam, and as the work turned three times as fast, this was distributed over the whole surface of the cam being relieved. This relieved the new cam to just one-third the depth of the old one and the job was done in about one hour.

England. LATHE HAND.

Bending a Hook

The inclosed sketch illustrates tools for bending the hook, which as shown, is more than a half circle. They consist of the punch *A*, which fits a suitable holder in the foot press, a stationary die *B*, which is a tight fit in the slot *H* and held in position by screws, and the tumbler die *C*, which is an easy fit in the slot *H* and located by the pin *D*. The hardened-steel piece *E* driven into the die *C* serves



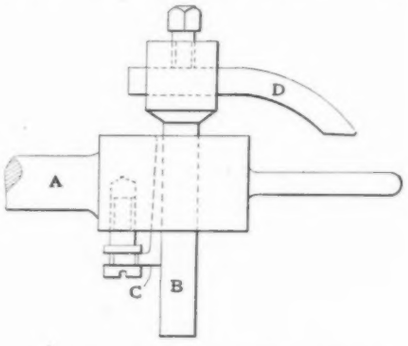
BENDING A HOOK

both as a stop for adjusting the die *C* to the right hight and for a weight to bring it back into position after the bending operation. In operation the wire is laid across the top of the dies *B* and *C* fitting in the grooves and against the gage *F* as shown. As the punch descends the hardened-steel pin *E*, resting against the screw *G*, resists the pressure until it reaches the lower part of the die *C*; the pressure then causes the upper part to tip forward, following around the form of the punch *A* and bending the hook as shown, as the punch ascends, taking the hook with it, the weight of pin *E* brings *C* back into position. The hooks are then knocked off by a spring knock-off fastened to the stationary part of the press while the operator is putting another wire in position. A girl can do 100 gross per day with these tools.

Winsted, Conn. C. W. R.

Tool for Machining Bosses

The tool consists of a body *A*, having a guiding end. A tool holder *B* having a square shank is fitted into a hole in *A* and can be securely clamped in any desired position by the gib *C*. The



TOOL FOR TURNING OUTSIDE OF BOSSES

large end of *B* has a square hole in which cutters *D* of any desirable shape can be placed.

In using the above tool a hole is drilled at the center of the boss for the guiding end and the boss can then be machined exactly in the position desired, while if a hollow mill is used it would be apt to center itself by the boss, and if the boss on the casting was not in exactly the correct position it would probably be incorrectly located when finished.

Philadelphia, Penn. W. ALTON.

Securing Pieces with Taper Key

Designing a machine where securing a piece by a taper stem keyed in seemed to

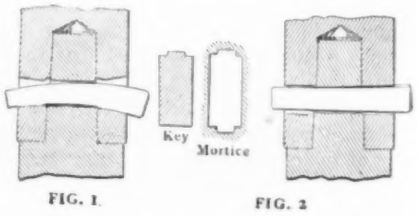


FIG. 1. FIG. 2

SECURING PIECES WITH TAPER KEYS

be the most promising way, and where a key to force the stem out did not seem feasible, the plan shown in Fig. 1 was thought of.

As shown, the key would draw the stem in, and by turning it over and driving it would force the stem out.

This brought to the mind of the pattern-maker a plan that takes the form shown in Fig. 2, which would not call for such special tools for construction. Mortises would be more simple, though the key would be more expensive; but only ordinary machine work would be required for its production.

In either case there would be extra expense unless something was saved in other ways. But the special key or mortise has to be made only once, and the mortise in the changeable pieces are plain and as simple as any, only requiring care in the size and location.

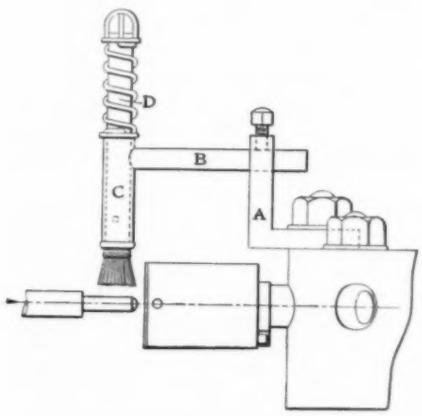
Both may be old, and some of your readers may show us a better plan.

Syracuse, N. Y. L. TRIX.

A Turret Oiler

Fig. 1 shows an oiler I devised for use on the hand-turret lathes. We had quite a little trouble with some soft-brass work stripping the threads by clogging the dies until we used oil for the threading. As it was essential for a future operation to avoid oil and grease as much as possible, the boys dabbed the screw blanks with an oily brush until I devised the oiler shown.

Fitting under the clamp nut for the die-holder is an iron angle *A* bored for the shank *B*, which is adjustable and fixed in position by the screw shown. On the end of the shank is brazed a piece of tube about ¾-inch internal diameter, which is



HAND OILER FOR TURRET

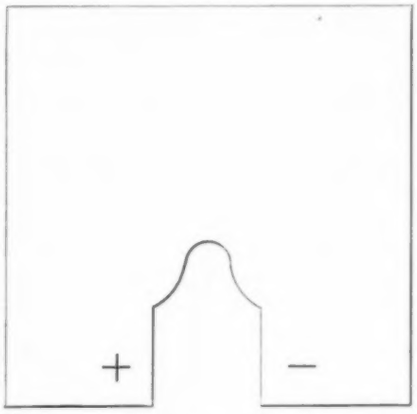
an oil-tight fit over another tube *D*. About ¾ inch up from the bottom of the inner tube a hole is drilled, and screwed in the bottom is a plug which has a tuft of bristles affixed. Over the upper part of the inner tube is a spring and washer, and on the top two cross loops of wire are soldered.

When adjusted the brush is about ½ inch above the screw blank. The inner tube is filled with oil and when depressed the oil runs from the hole on to the brush and the work, the duration of depression determining the amount of oil required. When the pressure is removed the tube moves upward and automatically cuts off the oil flow. The wires across the top prevent the oil squirting out, as would be the case with the hand pressing into a partially empty tube.

London, England. W. MADDISON.

A Gear Cutter Test Gage

Recently we had to make four machine-relieved gear cutters 3 inches diameter to cut four rack teeth simultaneously, each cutter to be dead to size in diameter and thickness. A piece of rack was sent as a pattern and the cutters were to



A GEAR-CUTTER GAGE

be perfectly interchangeable, having to work in a gang on one spindle. Now, making the cutters all one diameter, thickness, and form, is a very easy matter, but making the tooth form exactly central, was a bit of a puzzle, until I hit on the following device:

On measuring the piece of rack, it was found to be 13 millimeters pitch. I, therefore, allowed 0.030 above finished size for the thickness, and had the cutter turned as near central as possible to scribed marks on the piece of rack. The cutters were then hardened, and ground internally. After this, a gage as shown in the sketch was milled, one for each cutter. On trying the gage the reverse way it showed double the amount the form of the cutter was out of center; each cutter was then ground on the full side, until the minus side of the gage fitted exactly to each side of the cutter, care, of course, being taken that we did not get below 13 millimeters in thickness. It was then an easy matter to take an equal amount off each side until the cutter proved to be 13 millimeters, finally cutting one more gage with a finished cutter, to try on both ways, thereby proving the tooth form to be exactly central. It speaks well for the turner who relieved the cutters that the greatest amount any was out of center was only 0.004 inch. JAS. HUNT.

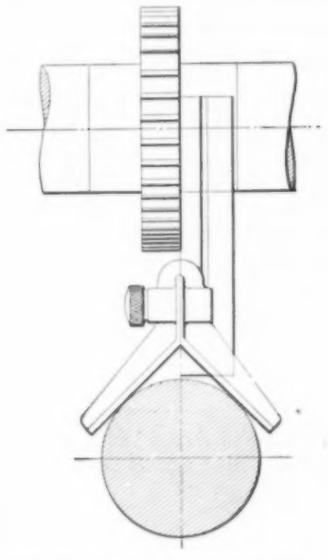
Sheffield, England.

Setting Milling Cutters and Work

As my former article on this subject brought out considerable discussion, I am led to present another phase of the problem. The accompanying figure shows the application of the center square to the setting of plain cutters such as are used in keyway cutting or splining. This tool is found in the average machinist's tool chest, and here is one of the many uses to which it may be put in milling-machine work. A small size is handiest. This size is provided with a 6-inch scale and a small head.

As shown, the scale is extended in the direction opposite to that in which it is usually used. With the center head resting on the arbor or shaft the central edge of the scale is brought into *fair* contact with the cutter; the knee is adjusted back and forth until such a condition exists. When this contact is obtained the central edge of the scale will be in a position perpendicular with the top of the table, and one side of the cutter will be central with the axis of the arbor or work. It only remains to move the table in the proper direction an amount equal to one-half the width of the cutter, if it is desired to have the slot milled central, as in splining.

This method is not only applicable to



METHOD OF SETTING MILLING CUTTER FOR SPLINING

work strapped to the table, or held between centers, but may be applied to jobs held in a chuck when an operation is being performed on the end of the work, such as clutch milling or in milling teeth on the side mills.

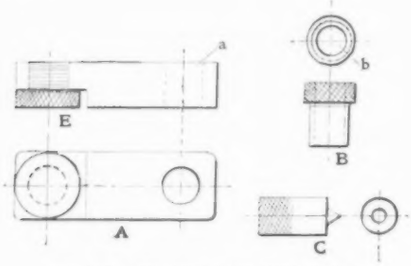
Having obtained a variety of methods for the setting of symmetrical cutters central with the work, it would not be out of place to have some ideas contributed as to methods used in setting the double angle cutters used in making milling cutters, especially spiral mills. The usual pro-

ceeding is a purely "cut and try method." Surely this problem can also be sifted down to a systematic basis.

Windsor, Ontario. DYNAMIC.

A Jig for Drilling Laid-out Holes

One of the difficulties that confronts the machinist is the drilling of holes within a fair degree of accuracy of the layout. As a means of obviating this



JIG FOR DRILLING LAID-OUT HOLES

difficulty to a great extent, this tool will be found useful.

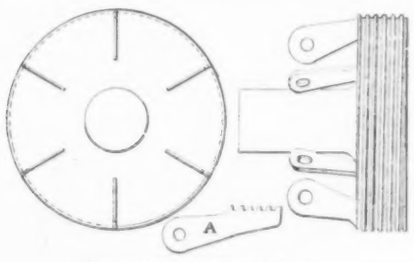
A is a piece of steel hardened, with hole *a* in one end and a threaded hole in the other, with part of the stock cut away as shown. *B* is a bushing to fit *a* with a hole the size of the hole that is to be drilled. *C* is a center-fitting hole *a*. *E* is a nurled-head screw to fit the threaded hole in the end of *A*.

To use the tool, lay out and prick their centers lightly. Place *C* in hole *a* with center end in pricked hole. Then strap *A* to the work, remove *C*, place bushing *B* in *a* and drill the hole. If the hole is to be in a curved surface, adjust screw *E* until the tool lies level and proceed as stated above. By having several bushings like *B* with various sizes of holes the tool will have a wide application. H. S.

Buffalo, N. Y.

Thread-pitch Gages

This style of thread had been in use for some time, used mostly on bowl tops for



MAKING THREAD GAGES

cream separators, the requirements of the case making it impossible to adopt any of the many styles of threads at present classed as standard.

The pitch of this thread was six threads per inch, the depth was 1/16 inch, and the width on top of the thread was 1/16 inch. The angle of the sides was 23½ degrees.

This necessitated a standard of our own and the test gages were made economically in the following manner:

A piece of steel scrap was roughly turned to about the size of the finished bowl, and six slots milled in it, parallel to the center line; then pieces of flat steel were fitted into the slots, after first being shaped to form a handle for the gage, after which the whole arrangement was placed in the lathe and turned and threaded exactly the same as a bowl, as shown, after which the flat pieces were removed and we had six test gages *A* that were an exact duplicate of the thread on the bowl top, and clearly showed what form the thread should be in the cap, in order to make a perfect fit for the bowl top, which was the main object of making the gages.

Guelph, Ontario, Canada. J. NENE.

A Simple Support for Drawing

Many mechanics or machinists who have occasion to work from shop drawings or blueprints and wish to lay out their work without going to the trouble

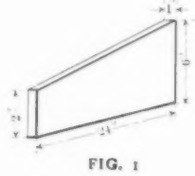


FIG. 1

FIG. 2

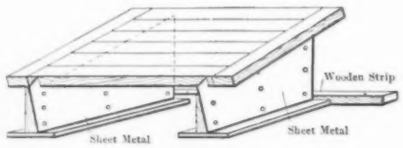


FIG. 3

SUPPORT FOR DRAWING BOARD

and expense of a special drawing table, to say nothing of the extra room needed, will find the simple substitute proposed very handy and workable. I have used it for many years with great advantage.

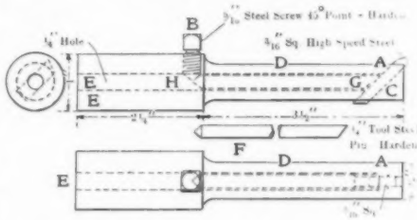
I have a small drawing board about 24x36 inches and I took two hardwood blocks 24 inches long of inch stuff and sawed them in a miter box to a gradual slant making them about 6 inches deep at one end by 2 inches at the other. I then took sheet metal and cut to the exact outline of the blocks, allowing the metal to project at the narrower end far enough to cut a stop at right angles to the slant and as deep as my drawing board. Fig. 1 shows the shape of the block and Fig. 2 the outline of the metal after being cut.

These two metal plates after being cut as described, I nailed firmly to the blocks, and in addition flat strips of the type metal 2 or 3 inches wide, are cut the length of the blocks and nailed upon their level side to furnish a firm base. They are then complete and the drawing board placed upon them with its lower edge resting against the stops is thus elevated at an angle, making its use for drawing or scaling off much easier. Fig. 3 shows the board in position.

New York. F. W. M.

Special Boring Bar for Turret Lathe

The accompanying sketch shows a new way of clamping the cutter in a turret-



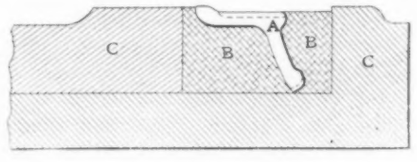
SPECIAL BORING BAR FOR TURRET LATHE

lathe boring bar. Some time ago we had a job come to the shop which was necessary to have a stiff small bar to true up the hole in some pulleys, the hub of which was 3½ inches long. So I designed the bar shown, which answered the purpose. The set-screw *B* binds the tool *C*, which keeps the small part *D* clear of adjusting and clamping screws. The hole at *E* is drilled through to square the tool hole. The pin *F* is of tool steel and is hardened on both ends; the pointed end is 45 degrees the same as the set-screw point, so when the screw is adjusted down at *H* it strikes the pin point and forces it back against the tool at *G*, thus clamping it in place. I have made several larger bars of this style using this same method of clamping the cutting tool, and have not been bothered by its slipping in the least.

Lowell, Mass. J. S. SCOTT.

Babbitt Jaws for Planer Chucks

We had some special compromise splice bars to make for rail connection which had to be planed, and owing to their peculiar and irregular shape, they were very difficult to hold on the planer. After several plans had failed, owing to their inability to hold the work securely



BABBITT JAWS FOR PLANER CHUCKS

against the action of the planer tool, I suggested the use of babbitt jaws as shown in the sketch. These jaws were made by casting babbitt around one of the splice bars held in the proper position and it was surprising, as well as gratifying, to find how well these acted.

The babbitt would bear against the splice bar along its entire length, and as the bearing area was extremely large, there was not the slightest difficulty of the splice bar moving under the action of the cutting tool.

I believe there are many places where a similar application of soft-metal jaws can be made and where irregular shaped pieces can be held easily and securely. It is no more difficult to put the work into a chuck of this kind than to clamp work between regular jaws, and I do not know of any other way of holding such work which can be compared with it.

REINHOLD BETTERMAN.

Johnstown, Penn.

Pressing Malleable Castings to Dimension

Nowhere have I seen a case of brains operating toward betterment that impressed me so much as an operation on a hydraulic press which took the place of a turning job on a lathe. Strange as this may sound, it is nevertheless true that the press did an operation simply, quickly, and cheaply, which had before been very expensive on a lathe. To make the case clearly understood, I will first describe the use to which the piece was to be put, and then the conditions under which it worked.

Fig. 1 shows the form of the piece. It is used as a casing inside of a cast-steel shell *A*, as shown in Fig. 2. This shell is bored inside for the case *B* to 3⅝ inches + .003; the case *B* is held in place by the lock cap *C*. This makes it necessary to machine the contact surface between *C* and *B*, and face the end. The casing must also be a close fit in *A*. When first used the piece was chucked in a lathe and the

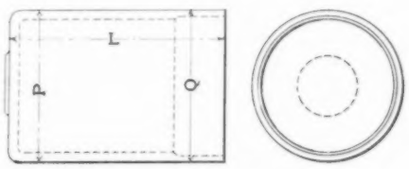


FIG. 1. THE CASTING

outside turned up to exactly 3⅝ inches for a fit in *A*.

I do not know whether it was the lathe hand who was not "making out" on his machining time for the outside of the case or whether it was the wonderful mind of the "old man," but from the nature of the case I think it was some freaky genius who knew nothing but just made what he thought was a "fool remark" when he said, "Why don't you *press* the malleable-iron cylinder to size?" No matter how it was, the thing was tried by rigging up a die from a simple block of steel, as shown in Fig. 3, by grinding a hole out tapering from 3⅞ inches at the top down to 3⅝ inches at the bottom.

This die was blocked up on a vertical-plunger, hydraulic ram, and after using a good daub of heavy grease the casing was rammed straight through at the first trial. Only a few little changes as to the size in the die were made, and after that they were fed through the die in rapid succession. The pressing was done previous to the machining operation on the end and inside and all the castings came out without breaking and to the exact dimensions.

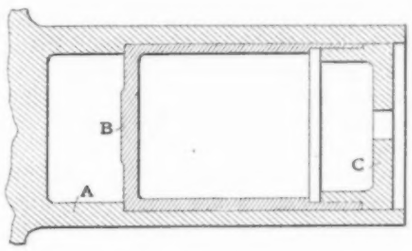


FIG. 2. THE CASTING ASSEMBLED

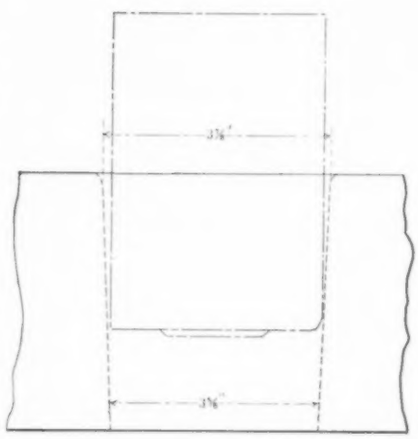


FIG. 3. THE DIE

These cases being malleable iron, were in many cases a good deal out of round, and to show how much actual metal was rammed from the outside, one particular piece I measured was so badly warped that the diameters at *P* measured 3⅞ inches in one place and 3¾ in another, while at *Q* it was 3 11/16 inches and almost round; the length *L* before pressing was 3⅝ inches. This was started through the die bottom end (*P* end) first. The gage registered from 20 to 27 tons as the press was being made. After pressing, the calipers showed the outside diameter to be exactly 3⅝ inches along the whole length, while its length *L* had increased ⅛ inch to 3¾ inches. The time required for pressing was about five minutes, and there was no perceptible heating in the piece.

This is a flowing process, all the metal removed in reducing this outside diameter goes to either increasing the thickness of the wall or else the length, as there is absolutely no shearing done in the entire operation.

WILLIAM LONGSTREET.

Pittsburg, Penn.

Cutting a Large Gear on a Small Gear Cutter

Cutting a 42-inch gear upon a 36-inch gear cutter was the problem confronting me recently. This gear, with an 8½-inch face, was cut 1½ pitch, which on a light machine, never intended to cut coarser than 3 pitch, seemed somewhat of an undertaking. In order to fit this gear cutter to accommodate such a large gear blank, it was necessary to remove the overhanging arm or support and in its place clamp a cast-iron sleeve *A*, Fig. 1, in which turned the arbor *B* holding the gear blank. To make the divisions, the arbor was revolved by the spur gears, *c c* having the same number of teeth securely keyed to their respective arbors. The driver was drawn into the regular spindle *D* on which the index worm was mounted. Great care was taken in cutting these auxiliary gears, as any error in them would be greatly increased in the large gear.

As the 1½-pitch cutter was altogether too large in diameter to clear the top of the saddle, it was necessary to raise the cutter spindle. Removing the bearing cap

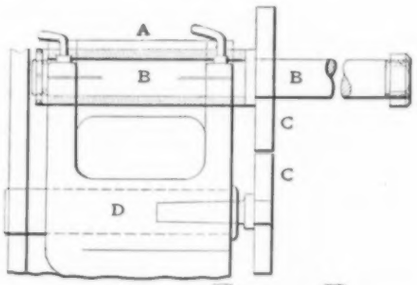


FIG. 1

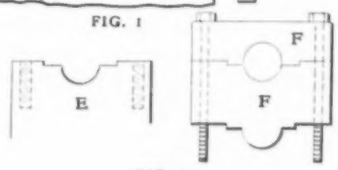


FIG. 2

THE ALTERATION ON THE GEAR CUTTER

from the box left a surface similar to *E*, Fig. 2. A special bearing was made *F F*, the lower half being made to accurately fit the surface *E*. This tended to keep the bearing in line and insured rigidity. The increased hight of this bearing necessitated a higher end bearing of increased strength to withstand the additional pressure. It also required a larger spiral gear on the end of the cutter spindle, which greatly increased the power.

The greatest difficulty experienced in cutting these gears was the tendency of the cutter to catch and bite in, upon breaking through the end of each cut.

This was due to the back lash and spring in the parts, and was overcome by hanging a weight by means of a chain and pulley to the spindle carriage, thus keeping a strong tension on it.

Slotting the heads of small screws, of various shapes and sizes, was always a source of annoyance, especially where they came in small bunches. The following home-made fixture was used with good success, not only in saving time, but also the wear and tear on the operator's

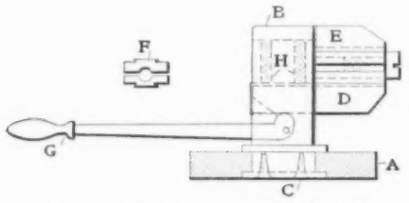


FIG. 3. SCREW-SLITTING FIXTURE

feelings. This fixture was adaptable to all sizes, and easily put on or removed from the milling table. It was designed to use upon a vertical miller, the slitting saw being held upon an arbor. It consisted of a base plate *A*, Fig. 3, on which was mounted the standard *B*. This standard was fitted to revolve in the base plate *A* and held in place by the flange *C* which was fastened to the bottom of *B* with screws. The upper or fixed jaw, was cast integral with *B*. The movable jaw *D* moved in the slot in the body of the standard, and was kept in position by means of a flange on the back end of the jaw and by a gib *E* on the front end. The different sizes were cared for by false jaws *F*, the thickness of the jaws corresponding to the difference in the diameters of the screws. This cared for the adjustment and added to the simplicity of the idea. The clamping was accomplished by bearing down upon the lever *G* which by means of the cam on end of lever raised the movable jaw. A slight motion to one side brought the head of screw against the cutter. The jaws are pushed apart by two spiral springs *H H* which upon raising the lever, released the screw.

Boston, Mass. Y. TEXAS.

Keyway Cutters

When cutting keyways or similar grooves in shafts, etc., on the ordinary slot-drilling machine the operation is naturally slow, and consequently expensive, due to the series of to-and-fro motions of the tool, and the amount of down feed to it at each end of the stroke being rather small on account of the form of cutter used.

In attempting to improve the output of our slot-drilling machine the experience gained may be of advantage to others using a similar type of machine.

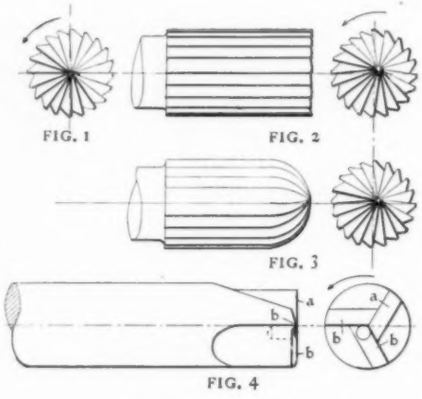
Having tried milling the grooves with an ordinary end mill, at a single traverse, this method presents no difficulties when one end of the keyway is open, but the largest part of our keyways and grooved work in general have blind or closed ends.

Now the trouble in cutting these grooves consists in getting an end mill to feed down into the solid metal the required depth before commencing to traverse it along.

Referring to Fig. 1, which shows one view of an end mill as usually made, the teeth converging to a point in the center of the cutter, form at that point a non-cutting or dead end, which prevents feeding this style of cutter to any great depth, without withdrawing a few times to remove the cuttings.

My next trial was with cutters made as shown in Figs. 2 and 3, the latter being for grooves having round or concave bases of different curvatures.

It will be noticed that these cutters



KEYWAY CUTTERS

have their cutting edges meeting in a point which is eccentric with the axis of the cutter, so that some of these cutting edges pass beyond the center line, consequently there is no dead end to prevent this style of tool being fed downward into the work in hand.

Parts of these cutting edges, viz.: those portions beyond the center, when in operation are dragging over the work, but this is a slight drawback compared with the advantage of being able to feed the cutter down into the work a reasonable depth.

There is no difficulty in cutting these teeth, as all that is necessary is a socket, bored eccentrically to carry the cutter shank, and attached to the dividing head chuck of a universal horizontal milling machine in the ordinary way.

These tools are very useful, among other purposes, for die-sinking work.

Another type of cutter was introduced to my notice some time ago by a friend engaged on similar work, the design of which, shown in Fig. 4, evidently being on the same lines as those shown in Figs. 2 and 3, and which for keyways at any rate gives very good results.

This drill is of such a form as enables it to be first sunk into the work the required depth, then a longitudinal traverse being given to it of the required length, thus finishing the groove at one operation.

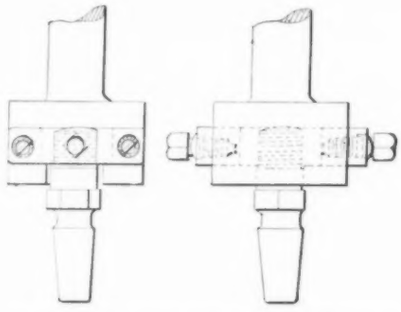
In this cutter a small hole is drilled down the end, eccentrically to the center. The cutting edge *a* passes just beyond the center of the cutter thus leaving no dead end, the other two cutting edges *b* are tangential to the circumference of this small hole, but do not reach to the center of the cutter. This type of cutter has been patented in Germany, but not in this country.

The results obtained by this cutter, and the small cost of making it, have justified me in adopting it for the purposes mentioned, and accordingly our slot-drilling machine has been modified to suit it, all that was necessary being to alter the comparatively quick to-and-fro motion of the spindle slide to that of a slow feed in one direction only, and provide an automatic knock off.

Sale, England. T. M. LOWTHIAN.

Adjustable Guide Pin for the Profiler

The accompanying sketch shows an adjustable guide pin for a profiling machine. It is strong, simple, and very easy to adjust. In shops where there are a variety of forms to be cut from models the adjustable pin is very useful, as one can get any desired position and distance between centers. It is composed of a body with straight shank to fit the pin hole in the head of the profiling machine, with a tightening nut fitted into a T-slot through which nut the guide pin screws up against



ADJUSTABLE GUIDE PIN FOR THE PROFILER

the metal at the top of the T-slot, locking the pin firmly. Two straps across the ends of the slot are tapped to receive ¼-inch screws for adjusting the pin when the nut is free to slide in the slot. This adjustable guide pin has answered for a great many jobs on which the non-adjustable type of pin could not be used without recutting the forming plate, which operation would entail considerable time and expense.

Hartford, Conn. GEO. F. QUINN.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

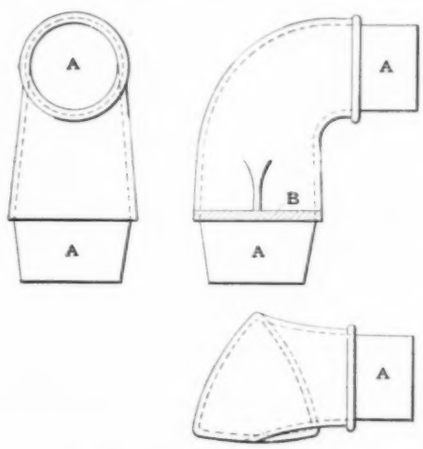
WE PAY FOR THESE ALSO

A Difficult Core

In the issue of the AMERICAN MACHINIST dated May 30, appears an interesting article in "Difficult Metal Core Box Work." This brings to mind a method I saw when working in a jobbing shop.

The job in question was interesting to me as up to then I had seen but little of the ways of the foundry or the pattern shop, but as some years have passed since that time and I have not seen a job done in a similar manner I send this on for the enlightenment of others.

A pattern was brought to the shop similar to that shown in the sketch herewith. This sketch shows a boxiron chimney and



A DIFFICULT CORE TO MAKE

the dotted lines show that it was to be cored out, and that the thickness of the metal was to be about one tenth of an inch in every part of the body.

The wood pattern was sent to the molder with orders for two castings from it. On receiving these from the foundry one was finished off for a metal pattern and the other was sawn through as per section *B*. From inspection it will be seen that it would be a funny job to measure it up for a core which would leave a wall of metal of exact thickness all over, as the shape varies from nearly an equilateral triangle at the one end, to a circle at the other. The idea on which the pattern-maker went to work was to secure from the casting itself a model of the hole which it had to contain.

This he accomplished in the following manner: The bead at the upper or circular end was filed off. A stop drill was then made for the job. This was simply an ordinary flat drill filed up on the end of a piece of drill rod and furnished with a collar to limit the depth of cut, viz., one tenth of an inch. The drill diameter was 0.25 inch. With this he drilled the surface of the casting all over, excepting, of course, the parts marked *A*, which, being the core prints, were the proper size. Having done this, the casting presented a pockmarked appearance, having holes one-tenth deep and one-quarter in width as close as they could be got. The pieces remaining between the holes were then filed away, leaving a more accurate model of the core than could have been got any other way. Having a correct model for the core it was a fairly easy matter to get either a plaster corebox or a metal one.

Birmingham, Eng. WILFRID GEORGE.

Proper Training for Engineers

When I wrote the article which was published at page 248, Vol. 31, Part 1, I was somewhat concerned for fear that Mr. Cardullo would take it personally; I had not thought that anyone else would take up the matter as Mr. Martin has done at page 806 because I thought that it would be a case of "if the coat fits put it on." But Mr. Martin reads more into my article than I can find there myself. What I read out of his is that I have stirred up a hornet's nest among the boys; for this I am not sorry. My principal point, and the one which Mr. Martin evidently takes the greatest exception to, is my advice to a boy not to follow certain instructions. I wish to say again, if any boy in any school is told that there is one absolute and only proper way to do anything, he will be as apt to learn to be an engineer by disobeying his orders as by obeying. This applies to any and every school.

As for an apprentice who has a foreman with these positive ideas, I advise him to do a lot of thinking, but keep his mouth shut. He cannot afford to throw up his job, nor can he afford to incur his foreman's displeasure. The boy who is in school is paying for his opportunity; he cannot afford to take any less than full value for his money.

Outside of pure mathematics I doubt if there is any knowledge that is universally accepted as definitely true. Someone is doubting and working to disprove everything. The teaching business consists in imparting to students large quantities of information which the teacher himself probably doubts, and may be working by himself to prove untrue. Teachers have to teach things as positive facts because they are not usually strong enough men to impress their students with the value of information other than that which is positive.

Now, don't for a moment think that I believe that all the sinners in this respect are college professors. They are to blame because they know better, but for every one of them there are a hundred "practical" men who do the same thing. They believe a thing the way it is first taught them. They vote the republican ticket, go to a Methodist church and use a little high-necked diamond-point tool because that is the way their father did; they never change unless they have to. If they had hand-cranks on the tailstocks of lathes in the first shop they worked in you can never make them see any virtue in hand wheels. They may agree with you when you are looking to save their pay envelops, but they will cuss the hand wheels when you are gone. It is not conceit in either case.

In the school it is feared that the slightest deviation from a set path will give a student an opportunity to topple his teacher over and let the rest of the class see the patch on the seat of his trousers. In the shop it may be thoughtlessness, pig-headedness or ignorance.

Unless Mr. Martin is very different and very differently situated from most men in his position he is turning out men, some of whom, in a very few years will develop into men who hold down much better jobs than he can. When these boys enter under his instructions they do it, not because his mentality is greater than their's, but because his technical knowledge of a certain limited portion of engineering is greater than their's. He is teaching some boys who have the ability to make large names for themselves. When these boys begin to come back, 5, 10 or 15 years after graduation, will he be able to say that he was justified in taking positive ground in their education?

It is true that it takes a strong personality to stand up before boys or men and acknowledge that one does not know it all. Unfortunately there are few that will, and still more unfortunately for shop and school such men can command higher salaries outside both schools and shops than in them.

Boston, Mass. ENTROPY.

Different Ways of Doing the Same Job

I read with interest the article under the above heading on page 654 of the AMERICAN MACHINIST and fully appreciate it. I often wonder how some firms conduct their business and on what they base their selling price; I am alluding to competitive lines, not monopolies or patented specialties. Mr. Laurence opens up a very interesting topic; but one very important item he does not mention is the different ways of doing the same job *in the same shop.*

Having had over 20 years' experience in responsible positions, I have seen some flagrant cases of mismanagement resulting in a few thousand dollars being squandered. I can refer to dozens of cases of jobs being done in different departments of the same works in totally different manners and on machines not suitable for the operation. The result was that the same operation sometimes cost three to four hundred per cent. more in one department than another.

SAVING 2 HOURS ON A 4½-HOUR JOB

A few examples which have recently come under my notice may not be out of place. Figs. 1 and 2 show a mild-steel forging of a differential bevel-gear blank to be machined all over. We had a quantity to finish and had one of our best men on them using a strictly up to-date lathe. His method of procedure was to grip the blank on the inside at the tapered part 7. This taper was slight enough to allow the chuck jaws to grip. Then he turned the blank to diameter at the extreme point 1, finished the surfaces marked 2, 3 and 4, bored the hole 5, then rechucked the blank, gripping on the part marked 3, and finished the surfaces 6, 7 and 8. This completed the blank. The time was 4½ hours each, in lots of six. This time is for an engine lathe. We next tried a lot on a modern turret lathe, using broad formed cutters. Although we had an expert toolmaker on the tools and a "good" man on the lathe, the time averaged 4⅓ hours each. So a great saving was not effected. No doubt some of the turret-lathe makers will say the time taken was excessive, but it was a fact that the turret operator could not reduce it. Much time was consumed in setting up.

A few weeks later we engaged a new turner on an engine lathe and gave him a batch of these blanks to machine; the way in which he tackled the job was a revelation to us. He "knocked all the stuffing" out of the other two men. This man gripped the blank on the part marked 1 and turned the parts marked 3 and 4. Then he rechucked, gripping on the part 3, and turned 1 to overall diameter; then he proceeded with surfaces 2, 6, 7 and 8. He also bored 5, which completed the job. The time was 2½ hours each. The same limits of accuracy were adhered to as in the two other cases; no special tools were made or used. Truly, this is a case of "back to the simple life" as Lodge & Shipley advertise. It shows what really can be done on a good engine lathe without special tackle when a good man is operating it.

Fig. 3 shows a machinery-steel crosshead pin that we manufacture. We usually make them on a turret lathe. The time averages about 35 minutes each. When the engine lathes are short of work, however, I have seen them sawn off in lengths to make two pins and turned up and threaded in an engine lathe. The time taken was about 2⅓ hours each. Truly, this is a case of philanthropy and is generally undertaken by a department foreman.

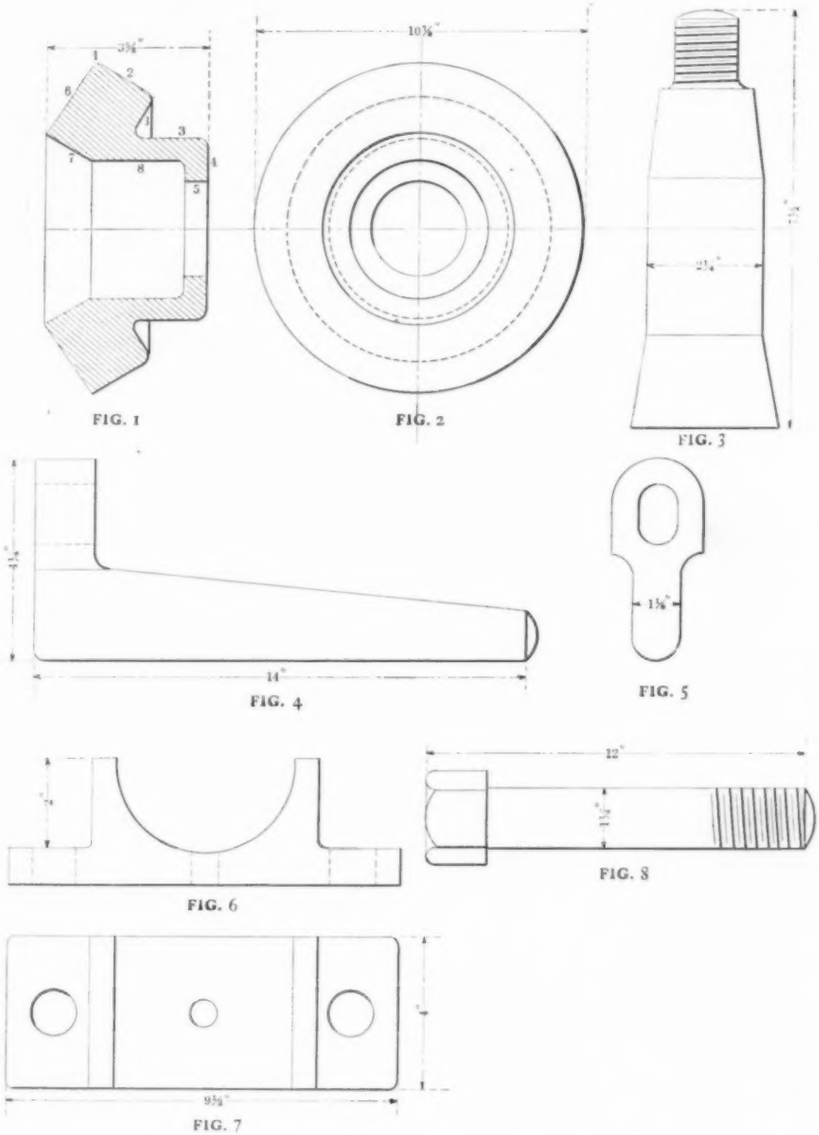
Figs. 4 and 5 show a forged-steel cotter. I have seen large quantities of these shaped and planed to size; the time taken was 7½ hours each and an indifferent job at that as a lot of filing was required to bring them up to a good finish. I have also seen them milled with ganged and formed cutters in 2¾ hours each. No filing was required beyond taking off the sharp edges.

800 PER CENT. SAVING

Figs. 6 and 7 show a crank-shaft bearing cap for a portable engine. These are machined a good fit to let into the bearings. I have seen large quantities shaped, averaging 13 hours each. In the adjoining department I have seen them milled, on the same day, with gang cutters.

They were fixed in a string jig: Time, 10 minutes each. This is an operation which particularly lends itself to milling.

Fig. 8 shows a steel bolt. This is a very common example. We make them from hexagon stock in a turret lathe in about 40 minutes each. Sometimes, however, they are made in an engine lathe taking 2¼ hours each. Goodness knows what the total cost is. A lively state of affairs! Of course, all shops are not like



SOME JOBS WHICH HAVE BEEN DONE IN DIFFERENT WAYS

this but when one has seen it, it makes you wonder how firms really base their selling prices, and how their estimating is done.

I am at present connected with a large firm building a line of air compressors. We buy small tools from outside. We recently sent inquiries to two of the leading tapmakers for some square-thread taps 1 inch in diameter. One firm quoted $2.50 each; while the other firm bid $7 each. We got them from the firm who sent in the lower tender. The taps are quite up to standard quality.

About the same time we sent out inquiries for some special box-tool holders for capstan lathes. Two well known firms, with equal facilities for manufacturing, bid. One firm quoted $30 each; the other $14 each.

Not long ago we had some gray-iron gears to cut, consisting of a spur-wheel with 100 teeth, 4 diametral pitch by 2-inch face, and a pinion to gear with it having 20 teeth. We sent out for bids. One firm sent in a price of $4.75 per pair; the other quoted $1.75 per pair. The latter firm secured the order. Their workmanship was first class and could not be beat. Of all estimating gear-cutting is one of the easiest. It is purely on repetition lines and can be calculated to within a very few minutes. The time taken on these wheels was about 5 hours per pair. Firm No. 2 wanted work, quoted low, got it and made a profit. Firm No. 1 wanted a higher rate of profit. Cases of this description are continually cropping up which make one wonder "what are selling prices based on?"

Manchester, England. J. HINDLEY.

A Tapping Attachment Applied to an Acme Automatic

Under the above title Mr. Klein describes on page 927 a device for which he claims advantages which I cannot see. In the first place the cost of the device would be quite a little and because of its complication it would be expensive to keep in repair. Secondly, a bad feature is that when the turret doesn't feed in fast enough to follow the tap, because you can't push a box tool or drill as fast as the tap will go in, the tap runs off from the pins and revolves with the work until the turret catches up to it again; so the rest of the tapping is completed by a series of bumps caused by the pins engaging and releasing.

Thirdly, there is no trouble with stopping the spindle for threading, the friction clutches are very simple and never give any trouble and there are other operations besides threading which are done in the third spindle for which it is necessary to stop this spindle, such as drilling a cross hole, or milling a slot in the work.

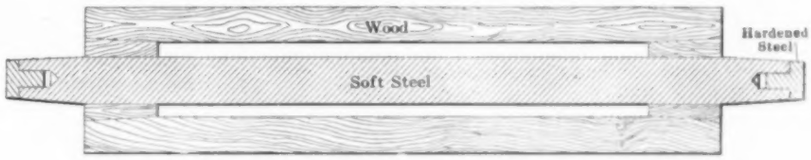
In regard to the claim that this device will increase production I should think that it would run the machines at a loss. Take the No. 53 Acme automatic. We run this size of machine on cold-rolled steel at 450 revolutions per minute and do threading and tapping with standard threads up to ½ inch diameter by running the machine in the usual manner, stopping the third spindle and revolving the tap at 120 revolutions per minute. Now, with this method, how much tapping can be done with the spindle running at 450 revolutions per minute? For a ⅜-inch tap this gives 45 feet per minute; a standard tap which would tap cold-rolled steel at 45 feet per minute would be a wonder.

The tapping or threading operation on an Acme is, 99 times out of 100, the shortest operation, so to slow the machine down to a speed where one could tap with the spindle running would mean a loss in production of about 50 per cent.

Lowell, Mass. PAUL W. ABBOTT.

Pin Gages

H. C. Gunson describes at page 735 his experience with the change of length in pin gages after hardening. We anticipated like results in making the Cornell measuring machine and it seems to me yet that the plan we followed was as good as any practiced since.



THE CORNELL PIN GAGE

As shown by the sketch, Stubbs wire about ¼ inch in diameter was used; the pieces about ⅛ inch shorter than the required length were drilled with a 3/32 inch hole at each end, and a hardened steel button about 1/16 inch thick driven in. Wood sleeves about ¾ inch in diameter, bored through with a ⅜-inch drill, were slipped over the rods and held central with conical wood bushes driven in at the ends.

The whole was then put in female centers in the grinding machine and the outside of the wood ground true and parallel; and then it was grasped in the V-lapping block and the ends lapped dead square and to length.

There are only the sixteenth buttons to change by seasoning and the rods are thoroughly protected from the heat of the hand when using.

Syracuse, N. Y. JOHN E. SWEET.

Some Vicissitudes of the Job Shop—The Skewer Pointing Machine

Permit me to express my appreciation of the last chapter of "Some Vicissitudes of the Job Shop," the one appearing on page 837. I have only one fault to find with it; it should start off: Once upon a time—yet it took me back to my younger days when the world was generally good, and to the times when I used to read fairy tales. Too bad that events thus described do not happen any more, and especially that benevolent old men are getting scarce.

Of course, as far as the ethical features of the case are concerned, the boss acted right. But the people who wanted to have a skewer-pointing machine built were rather an innocent lot in spite of their moral obliquity; for they could have gotten one, or four for that matter, for considerably less money than the $15,000 which were offered as a bribe. We hear that the successful machine of the victorious firm cost less than $250 to build. Now the competitors only needed to give an order to some really competent designer of special machinery, and it would be strange indeed if such a man did not produce a satisfactory machine with as large or a larger output and at a much lower cost than the $15,000 mentioned.

Engineering, and even the building of special machinery, is quite an exact science. There is no magic about it. As long or as soon as there is a demand for a certain machine to do certain work, this demand can be supplied and the machine built, particularly if some other fellow has made one already. Then we know that the thing can be done and only have to find the best means to accomplish the end.

As to this skewer-pointing machine: I do not know how this appliance was built, but learn only, that the output per machine is somewhere between 150,000 and 175,000 per day; say 20,000 an hour. Without analyzing the problem very deeply, it is clear that one man could not handle so many pieces in that length of time; besides, we read that he attends to several machines. Therefore, our machine must be automatic and self-feeding. As the machine could not perform 20,000 separate operations per hour, even as an automatic, it must be in multiple, that is with probably a series of knives, perhaps 10 or 12, suitably arranged.

If we knew whether the skewers come cut to lengths or in rods, the problem would be very much simplified. The probability is that they are cut to size and the pointing is merely a finishing operation. A magazine or hopper would have to be provided. This hopper may connect with tubes leading to a series of automatic chucks. The cutting and pointing may be performed by either revolving the knives in the cutter-head or revolving the chucks. Another solution, probably simpler, would be to have the skewers drop from the tubes into a universal flat disk chuck, similar to the style now used in some automatic screw slotters. It is then simply a question of speeding up the machine and according to my experience at least, there would not seem to be much difficulty in this problem.

Of course, this is considering the matter in a rough way. But as there are no impossible mechanical movements required and really only a combination of several well known mechanical devices, such as cutter-head, magazine, feeding and chucking mechanism, a thorough investigation of the problem would probably result in quite a large number of likely solutions. It is then only a matter of experience and judgment, with possibly some little preliminary experimenting in regard to the cutter-head and best cutter arrangement.

The proposition would have to be worked out and studied out, but I maintain that it could be done comparatively easily, if anybody really cared to have it done and for a great deal less money than the party is said to have offered.

Did Mr. Dornbirer know the boss or did he only hear of him?

Chicago, Ill. Jos. BLANSTEIN.

A Machine-shop Square That Is a Square

On page 930 Professor Sweet makes a statement which in itself is entirely correct, but which accepted at its face value has led many a good toolmaker into an erroneous assumption. He says, speaking of originating true angles and surfaces: "A straight-edge is one of three, any two of which when placed together coincide throughout their entire length." This is correct *only when the straight-edge is a knife-edge.* To illustrate: Some years ago when working as toolmaker, the foreman brought me three straight-edges about 3½ feet long by 1½ inches wide. He wanted to have me go over them and see what was the matter with them, as the work which had been scraped to them—some square plungers—did not come true. He said, "They—the straight-edges—ought to be true as we had a good toolmaker on them and he spent over a month scraping them." I tried them against each other in *all combinations* and *reversed* them and found they had a fine bearing in every case. I next laid one of them on the table of a large milling machine and found that it bore on two opposite corners ; it was so bad that I could feel it rocking. I tried the other two and found them bearing in exactly the same places.

After scratching my head awhile I was forced to the conclusion that with three straight-edges having any appreciable width any two could be placed together, and coincide throughout their entire length and still not be true (flat) surfaces. They could have a beautiful twist in them, due to the fact that in originating them they were not wide enough to be placed on each other at right angles as is possible when making three true plates.

Germantown, Penn. E. A. ERMOLD.

Public Industrial Schools.

After reading and re-reading the article by Mr. Hayes, at page 693, on industrial schools, manual-training schools and trade schools, I took pains to look up the author and found, as I half suspected, that he is connected with the Massachusetts Commission on industrial education as a special agent. Therefore, I feel at liberty to judge that his views are at least inspired if not actually authorized by that body. If that is the case, and if I have read the correct meaning into his words I am inclined to be sorry for the old Bay State.

So far as his views of manual-training schools are concerned I do not care whether he is right or not; I cannot feel that their value as feeders for technical colleges is large. I have a friend who is connected with one of these technical colleges as a professor; he declares that the manual-training school boys are in no way better fitted than those from other schools. He says that they have to unlearn so much that is taught them that it balances all the good that they may have received.

WHAT IS A TRADE SCHOOL?

The main point is whether or not Mr. Hayes or the commission have a right to define a trade school, or set up the new name of industrial school. By legal sanction in Massachusetts an industrial school is now a sort of reform school for unfortunate boys and girls. It would be a most unfortunate thing to set up another school, to which it is desired to attract the best of boys and girls, and give it a name which would rank it but little different in the public eye from a reformatory or jail.

As suggested in the editorial at page 776 the most serious problem to be faced in the promotion of schools for the teaching of trades is the getting of boys into them. The name will have a wonderful bearing on this question. The name best adapted to describe what ought to be done in these schools has already been taken by the manual-training high schools. Professor Sweet has taken the name of Artisan School, but I believe he would be willing to grant a State right to its use. The objection to the use of the name "trade school" lies mainly in the abuse of that name in some of the larger cities, where private adventurers in the field of education have established schools for the teaching of trades or single branches of trades, without making any attempt to discover their underlying principles, to say nothing of teaching them. These schools in many cases have brought discredit on their names.

Their attempts to provide skilled help at short notice result in the turning out of many men as skilled workmen who are totally unable to rise to an emergency on account of their entire lack of developed mechanical sense. I hope it was to this class of trade schools only that Mr. Hayes referred by that name in his article. There are, however, trade schools which are called by that name and which do not come under that description and which are slandered by Mr. Hayes.

THE INDUSTRIAL SCHOOL

Now for the new thing, the Industrial School; which name I believe is sanctioned by this commission as well as used by Mr. Hayes. This is a scheme which was fathered by the commission in its earlier days and one which I had hoped it had dropped. This Industrial School, to strip it bare, is a sop to the labor side where none is needed. It says to the manufacturer. "We will educate a man for you," and it winks the other eye to the workman and says, "Only we won't educate him so that you would know it when he gets in the shop with you." Unless men have changed vastly since I wore overalls as a regular thing they will not care any more for such subterfuge than the manufacturers.

Its prime essential is the condition that it will not teach the boy enough so that he can go out as a journeyman and ask journeyman wages. Its teachers want to teach "basic principles," but not dexterity; they want to teach the "allied sciences" but not to educate their students into the habit of doing good quick work. In a word, their aim is not to teach a trade at all. Perhaps, on second thought, they are entitled to the name of "industrial school" and to be compared with those prison schools of the same name, for they stand for the chaining of the pupils to the pedagogical idea to the exclusion of the practical work-a-day and workable idea represented by Sweet, Higgins and Alexander.

WHAT IS NEEDED AND DEMANDED

Let us see what is needed and what is demanded. There are three parties to this matter: The employer who needs and demands skilled labor; the boys who need skill and demand nothing, and the rest of society who need every man to be educated in the direction which will make him the most useful citizen.

This last party furnishes the active force in Massachusetts and is represented by educational associations. The boys are passive. Just at present the manufacturers are also passive through fear that the State will establish something in the school line that will be little, if any, more satisfactory than the manual training schools. To interest the latter they must be shown that a broad education along all lines that are of value to an artisan will be offered, and education that is broad enough to recognize that the practice of a trade under commercial conditions is education of the most essential kind. Of course, no school can offer a finished product, but a school which proposes to furnish men who have yet to serve an apprenticeship of three or four years before being worth going wages cannot expect the unalloyed enthusiasm of business men.

It is recognized by all manufacturers that if a machinist is hired from another shop, no matter if it is doing similar work, it will take him an appreciable time to adjust himself to new ways. They will expect just the same from the trade schools. I, for one, can see no reason why a shop with a school attached should not turn out at least as competent workmen as a shop without a school. It all depends on whether the shop is run by a school teacher or a mechanic. If a trade school does not turn out in four years' time a grade of workman capable of immediately commanding going wages, such as he could have gotten after four years apprenticeship in a good shop, then the trade school needs a new head.

The Boys

As for the boys: Their attitude is a large part of the problem, but I do not believe that it is insurmountable. In a private school the paying of wages is the natural inducement to offer. Despite Professor Sweet's discouraging view of the situation I feel certain that by the time he has four classes of boys which have been with him one, two, three and four years, respectively, he will have a force capable of earning enough so that by a careful use of the premium plan he could profitably pay them wages. The experience of the General Electric Company at Lynn has convinced them of the profitableness of their plan. It has impressed them sufficiently so that they have raised apprentices' wages and have, I understand, decided to establish the same system at Schenectady. The Lynn school has the advantage of a large and varied assortment of work from which to draw the jobs that seem best adapted to the apprentice's education.

A school run at the public expense probably could not pay wages for political reasons. It must offer other inducements. The inducement that colleges in the earliest times offered was social standing. That is something that the earlier technical schools could not offer. They could only offer the hopes of greater income. Gradually the sentiment of educated men has changed, largely as a result of finding that the technical school product did not invariably eat peas with a knife. Now a technical graduate has a social standing which is easily worth its cost. The public trade school has the same thing ahead of it. A fight against public prejudice is as certain as death and taxes. A few broad-gage, fair-minded mechanics in charge of such schools spell ultimate success; a few narrow men, mechanics or not, spell ruin.

A broad-minded man will draw boys to himself. A man who does not draw them should get another job after he has given himself a fair chance. The personality of the man is everything in this game. He must be able to make the boys' work so attractive that they will not realize that it is work. He must be a missionary to go among boys and pick out and win over to his schools the ones he thinks will do him credit in later life.

Coöperation of Manufacturers

The question of the probable success of public trade schools in Massachusetts seems to me to depend largely on the attitude of the commission toward manufacturers. I believe that none of the commission with the exception of Mr. Higgins has any acquaintance with a machine shop at first hand. If the commission does not take the views of manufacturers into consideration, it is likely to run into a long and expensive experience in learning what is already A, B, C to the people who are willing to help if they may.

Boston, Mass. Ex-Manufacturer.

Another Turret Tool Holder

On page 908 you publish a description of a "vertical turret tool holder for the lathe," designed by Frank E. Bocorselski, and for which a patent has been applied.

I inclose you two photographs of a turret I designed and made five or six years ago, and which has been in use ever since, in fact it has become almost indispensable.

Fig. 1 shows the turret attached to an angle iron which is clamped down in place of the tool post, making a very rigid construction. Fig. 2 shows the same turret attached to a shank held in the tool post, and is fitted with worm attachment for turning ball-shaped bearings. The turret was originally attached to shank in Fig. 2 where the center-screw hole is partly covered by bracket supporting the worm. To adopt it to lathes of different swings the angle iron was substituted and holes tapped in it for the various hights; the supporting screw upon which the tool rests while taking a cut passes through a movable block controlled by a flat spring. This screw is raised or lowered so that parting tool will cut to center of stock; one setting of this screw answers for all tools, as stock is of uniform size and faces of tools are all milled same hight from bottom. The screw is thrown from underneath the tools when turret is turned to engage the next one.

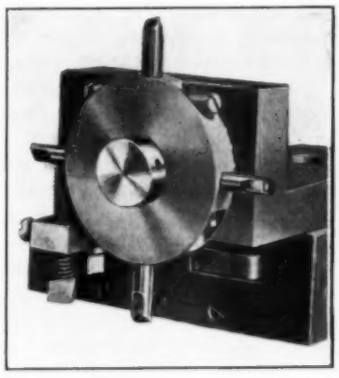


FIG. 1

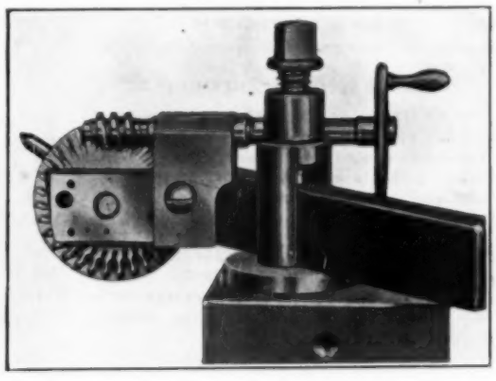


FIG. 2

ANOTHER TURRET TOOL HOLDER

Cleveland, O. J. C. Ulmer.

In connection with the Panama Canal work there is an up-to-date machine shop at Cristobal which has recently been equipped with many new machines maintained for the Colon dredging division. Since the American occupation up to the first of February, 1908, there has been a total excavation by dredges of 4,540,080 cubic yards and by steam shovels 235,686 cubic yards. On the Culebra division the Americans have already removed 14,264,869 cubic yards up to the date mentioned, which division, it must be remembered is extremely rocky. For purposes of blasting there are three compressor plants maintained supplying compressed air into a 10-inch main, with a capacity of 2500 cubic feet per minute at 100 pounds pressure.

The Turkish army is adopting automobiles. A French firm succeeded recently in securing an order to supply six automobiles, each costing £2400, and they have been delivered in Constantinople. History does not relate whether they have yet been paid for!—*The Engineer.*

AMERICAN MACHINIST

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None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Self Support by Engineering Students

In another column of this issue will be found a paper by Prof. Herman Schneider, of the University of Cincinnati on the results so far obtained under his co-operative plan of engineering education.

Gratifying as are the results set forth, there is still room for more to be said on that phase of this system whereby the students earn enough money to largely defray their personal expenses while obtaining their education.

The providing of facilities for self-support by students has long been a dream by many American educators. It was a leading thought in the mind of Ezra Cornell when founding Cornell University and in the early days of that institution much was made of it, and, while many students in that and other institutions continue to do much toward maintaining themselves while pursuing their studies, we believe that no institution can be named where the conditions are so favorable as those offered by the University of Cincinnati.

It may be objected, and, indeed, it has been objected by some, that Professor Schneider's plan gives a student more shop work than an engineer really needs and that from the educational standpoint some of the time spent in the shops might better be spent at the university. No one would, we believe, have the hardihood to state that the large amount of shop work does the students any harm or, indeed, that it fails to do them good, the only adverse criticism that we have heard being, in effect, that greater benefit would be obtained if part of the time now spent in the shops were spent at the university.

In view of the facilities for self-support which the system offers, we look upon this as a piece of hyper-criticism.

When we consider the kinds of work to which students are compelled to resort elsewhere in order to earn money—janitor service, bookkeeping and unskilled manual labor—work which is of no educational value and which from an educational standpoint represents nothing but loss of time, and then contrast this with the Cincinnati method by which each student obtains his living or a good part of it as a by-product, so to speak, of the educational system through which he is passing, it will be seen that Professor Schneider has done something more than inaugurate a new educational plan.

It is well known among educators that engineering students carry a heavier load of work than those in other departments of university work, a fact which makes self-support by them more difficult than by others. When the amount of work exacted of engineering students in any good school of engineering is considered, the possibility of self-support by them seems almost hopeless, and it is precisely here that Professor Schneider has stepped in and offered a plan of which self-support is an integral part. Had this not been done, it would have been declared impossible and having been done, albeit by the simplest and most obvious of methods, it deserves to be recognized as an educational achievement. It places engineering education within the reach of those who must otherwise have gone without it and we are at a loss to decide whether the plan is the more admirable from this or from the purely educational standpoint.

An Industrial School for Worcester

Our readers are already informed of the advanced position taken by the State of Massachusetts in the matter of industrial education, through the appointment of a commission and the enactment of laws authorizing the establishment of industrial schools, to be maintained partly at the expense of the State, and partly at the expense of the localities in which the proposed schools are to be situated.

The city of Worcester has taken the first step toward availing itself of the provisions of this law, through the appointment of a local commission, which has just rendered a report recommending the establishment of such a school for the training of boys in the metal trades; the report being accompanied by a request for an ordinance authorizing the carrying out of its plans. These plans call for an expenditure of $133,000 for site, building and equipment of a school capable of accommodating 200 day pupils and 200 evening pupils, while the estimated annual running expenses are expected to be about $22,000 for the day school and $4500 additional for the evening school, one-half of the cost of maintenance being defrayed by the State.

The school proposed is to be substantially on the lines of the half-time school plan proposed by Professor Higgins in a paper read before the American Society of Mechanical Engineers some years ago. Professor Higgins was chairman of the commission making the report and he is to be congratulated upon the opportunity thus offered to put his plan into use. The report is quite complete and includes a schedule of the work to be done throughout a course of four years' duration.

A novel proposition for the armoring of war vessels has been proposed by an Italian engineer, in the shape of reinforced concrete instead of steel armor plates. This material would of course be held in shape by the ordinary steel shell plating of the vessel. For a given resistance, the weight and space occupied would be about the same as at present, but the immense saving in expense in favor of the new system would militate largely in its favor.

New Publications

THE THEORY, DESIGN AND CONSTRUCTION OF INDUCTION COILS. By H. Armagnat. Translated by Otis Allen Kenyon. 212 5⅛x8⅛-inch pages and 109 illustrations. McGraw Publishing Company, New York City. Price, $2 net.

Although induction coils are widely used today, especially for gas-engine ignition, their design is almost entirely on an empirical basis, as there is a lack of knowledge upon which to base a practical working theory. Many obscure points have been cleared up by Mr. Armagnat and are treated of in this work. The chapters on the construction and uses of induction coils should prove especially helpful. A valuable feature is the chapter on "Bibliography"; here the majority of articles dealing with induction coils printed from 1831 to the present year are briefly digested.

ACCIDENTS. THEIR CAUSES AND REMEDIES. By Thomas D. West. 95 5¼x7¾-inch pages. The Competent Life Book Agency, Sharpsville, Penn. Price, 25 cents.

Much that is effective in calling the attention of the public to the appalling loss of life in this country from accidental causes has been written, but nothing that we have seen is more so than this pamphlet. Its introduction states its purpose in the following words: "This pamphlet is presented to the men and women of America with the view of setting forth the causes of our country leading all other nations in accidents and with the object of offering many original suggestions for remedies, which if followed would greatly increase that care and faithfulness so necessary to prevent them." Mr. West has organized an anti-accident association and is actively engaged in arousing the attention of the public to the importance of this subject. He deserves every praise and his pamphlet deserves the widest possible circulation.

ELECTRIC LIGHTING AND HEATING. By Sidney F. Walker. 438 6⅛x4-inch pages, 272 illustrations and 246 tables. The Norman W. Henley Publishing Company, New York City. Price, $3.

The work is divided into eight sections which, in the sequence in which they are printed, treat of the following subjects: Electrical units; generators, transformers and accessories; accumulators; switchboards and switchboard trimmings; systems of distribution, cables, etc.; measuring instruments; lamps and accessories; apparatus for heating by electricity. Although both of the words "lighting" and "heating" appear prominently in the title, the section devoted to heating only covers 14 pages. In the author's preface we read, "Throughout the volume the endeavor has been made to provide as much information as to sizes, weights, efficiencies, dimensions, etc." In following out this line of endeavor there has been a copious use of material furnished by the builders of electrical machinery and accessories. In fact the bulk of the volume is devoted to descriptions of manufactured apparatus and tabulated data concerning it. As the work is of English origin, naturally English apparatus predominates.

THE PRINCIPLES OF MECHANICS. By Henry Crew. 290 5x8-inch pages and 110 illustrations. Longmans, Green & Company, New York City. Price, $1.50.

It is a pleasure to review a work written in such a clear, interesting style as we find in the book before us, and especially so when the work is on such a theoretical subject as pure mechanics, and written for a text book. The material in the work represents a lecture course that has been given for several years past to second-year students in physics at Northwestern University. The method of treatment has been most happily selected, for, realizing that pure mechanics is theoretical and may degenerate into a mere set of problems to illustrate and use the integral calculus, the author has taken the position that equations serve only to quantify certain experimental results and to predict certain facts in regard to natural law. Some of the author's efforts, as stated in the preface, that have brought commendable results were: "To build the discussion upon a few simple experiments and upon definitions which convey at once the physical meaning of the quantities defined. Thus, moment of inertia is presented at the outset as the rotational inertia of a rigid body, and not as the integral of the second moment of mass. To confine the treatment to that part of mechanics which is common ground for the physicist and the engineer. To reduce the inherent difficulties of the subject to a minimum by treating dynamics in two analogous parts—rotational and translational. The chapter headings are: Kinematics; Kinetics; Some Applications of General Principles to Special Problems; Friction; Dynamics of Elastic Bodies; Fluid Motion. We recommend this work to the consideration of student and engineer alike, who need for use or reference a work setting forth in a clear and comprehensive manner the principles of pure mechanics.

THE STRENGTH OF CHAIN LINKS. By G. A. Goodenough and L. E. Moore, 73 6x9-inch pages and 37 illustrations. Bulletin No. 18 of the Engineering Experiment Station of the University of Illinois, Urbana, Ill.

This is one of the most interesting and, in the machine-building field, one of the most important of the bulletins yet issued by the Engineering Experiment Station of the University of Illinois. The theoretical work was begun in 1900. This was followed by extensive experimental investigations to check the accuracy of the theories and deductions therefrom. It is pointed out that only meager consideration has been given to the strength of chain although it is one of the most useful and familiar of mechanical devices. We quote, "In view of these facts it is surprising that the chain has received scant attention from investigators in the field of elasticity and strength of materials. Aside from two or three scattered memoirs, the theory of the stresses in chain links has been untouched." The work of Unwin, Weisbach and Bach is reviewed and a table presented to show the unit stresses upon which their formulas are based. It is:

	Open Link.	Stud Link.
Unwin	{ 33,600 { 28,000	{ ..... { 40,320
Weisbach	33,375	35,600
Bach	{ 34,375 { 27,600	{ 33,000 { 26,400

These unit stresses are much in excess of the values regarded as permissible in machine construction using reasonable factors of safety. The formulas proposed by the authors for the strength of chain links are:

$$P = 0.4\, d^2 s \text{ (open)}.$$
$$P = 0.5\, d^2 s \text{ (stud)}.$$

where P is the load in pounds, d the diameter in inches, of the bar from which the chain is made and s the permissible unit stress in pounds per square inch. The following conclusions are of interest as bearing upon certain general opinions held by engineers in regard to chains. We quote, "The introduction of a stud in the link equalizes the stresses throughout the link, reduces the maximum tensile stresses about 20 per cent. and reduces the excessive compressive stress at the end of the link about 50 per cent.

"The stud-link chain of equal dimensions will, within the elastic limit, bear from 20 to 25 per cent. more load than the open-link chain. The ultimate strength of the stud-link chain is, however, probably less than that of the open-link chain.

"In the formulas for the safe loading of chains given by the leading authorities on machine design, the maximum stress to which the link is subjected seems to be underestimated and the constants are such as to give maximum stresses of from 30,000 to 40,000 pounds per square inch for full load."

Exports to Germany in automobiles and parts during the period of 11 months ending May, 1908, showed an increase over the same period a year previous.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Tools for Use with Renold Silent Chain

Since the introduction of Renold chains into America by the Link-Belt Company, Philadelphia, Penn., their use has become quite common in machine tools and repairs occasionally become necessary. As

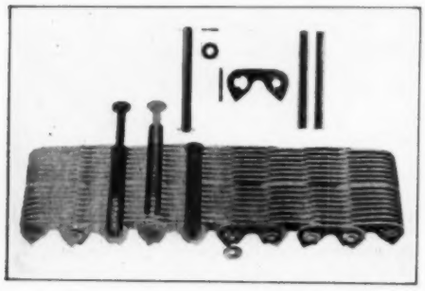


FIG. 1. CONSTRUCTION OF CHAIN

the chains are quite familiar, this refers principally to two novel accessories for assembling, though a brief outline of the improvement in the joint of the chain is included. As shown by Fig. 1, two semicircular bushings are used in each joint, both being of a length equal to the width of the chain. This new arrangement besides allowing for the proper articulating movement, permits complete rotation of the pin, which is of decided value, inas-

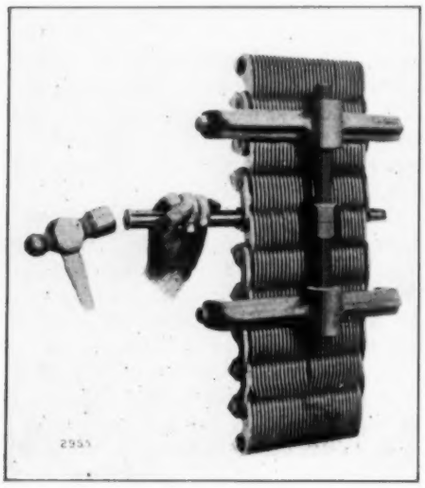


FIG. 2. TOOLS FOR CONNECTING A CHAIN DRIVE

much as possible wear is thus rendered free from unevenness, while the accuracy of fit minimizes any tendency to elongation with its accompanying wabble. Another point made in favor of the new construction is the complete absence of contact between links and pin, which relieves the latter of concentrated pressure and eliminates the internal wear so destructive to proper service.

To aid in installing these chain drives, the makers have devised special appliances for the work of connecting the links. Fig. 2 shows what is termed a "cramp"—a specially designed holder made of cast-iron members for gripping the ends of the chain, and connected by a screw for drawing the gripped ends together when fastening them. This is accomplished by fitting the bushings to a short drift pin of proper diameter to lead into the holes of the links, after which the pin is inserted and with a few light blows is driven into position.

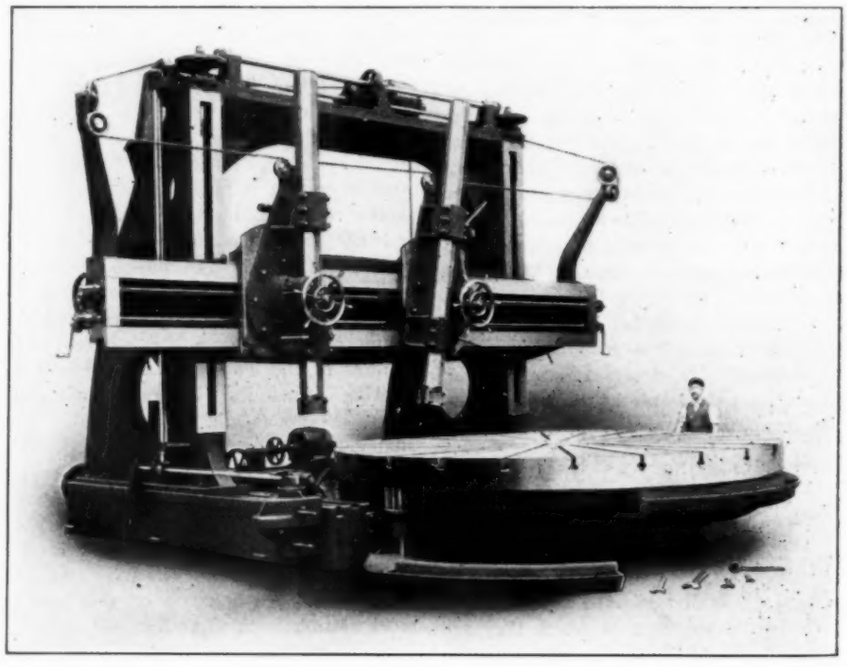
A Heavy Extension Boring Mill

Where most of the work is small but an occasional large piece is encountered, an extension mill may be used advantageously. When the housings are forward, it is as convenient as a small mill, while for large work the housings may be run back and the swing increased six to ten feet. An extension arm is usually provided on which there is an auxiliary swiveling head having power feed working to the center of large pieces when the housings are run back. The housings are moved back and forth by power.

This machine is an especially powerful tool with the following dimensions: Swing with housings forward, 16 feet; with housing back, 25 feet. Greatest hight under tools, 96 inches. Travel of bars, 72 inches. Diameter of table, 192 inches. It is driven by a 50 horse-power motor having a speed variation of two to one. A 15-horse-power motor is used for moving the housings back and forth and a 14-horse-power motor is used for raising and lowering the cross-rail and for operating the quick traverses of the bars and saddles. A trough is provided at the circumference of the table for catching the lubricant, a section of this being taken down to show the gearing.

Table is driven by an accurately cut external gear and is supported by a wide, flat annular bearing of large diameter. For light work and high speeds, the table may be raised off the annular bearing by means of a step bearing under the spindle, which is of large diameter and has adjustment for wear by means of a taper sleeve. The lower step bearing runs in oil and is operated from the front of the mill.

The swings are graduated and swivel to an angle by means of worm and worm-wheel segment. Tool bars are octagonal in section with four sides scraped to a

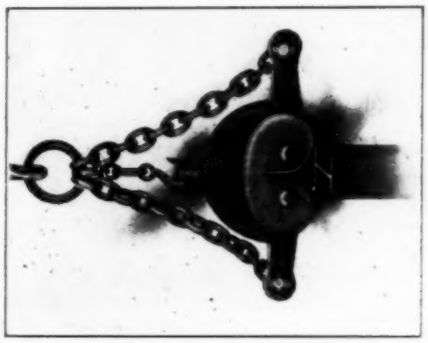


A HEAVY EXTENSION BORING MILL

bearing in their swings. This section is especially strong and it allows the bars to enter comparatively small holes when boring. Tool bars may be clamped when cross-feeding by binder bolts in the lower cap bearings. Tool holders are keyed in taper sockets so as to be readily removable from the bars for the insertion of other tools. Separate feed mechanisms are provided at each side of the machine. The feeds operate horizontally on the saddles and vertically or angularly on the bars. They are reversed or changed from roughing to finishing by means of convenient handles at each side of the machine. Changes of feed are made at the end of the crossrail, eight changes being provided. The crossrail has a deep arched double-walled back and is raised and lowered by power. The width at the center is increased so as to form a firm support for the boring reach arm. The housings have wide solid faces increasing the stiffness and have liberal bearing surface on the bed. This is built at the Niles Works of the Niles-Bement Pond Company.

Hoisting or Pulling Grip

Although the accompanying grip was designed especially for pulling sheet pil-



GRIP FOR HOISTING OR PULLING

ing, it is equally adapted for handling sheet metal of any kind with a crane or by other means as in boiler work. It is made entirely of steel with jaws four inches wide and having case-hardened teeth. The chain is ¾ inch of the best iron. The short chain holds the jaws apart so they can be let down over the sheet to be gripped, after which this is unhooked and the other chains do the pulling. The jaws are cam shaped and increase their grip the harder the chains are pulled. This is made by the Curtis & Company Manufacturing Company, St. Louis, Mo.

Personal*

Harry A. S. Howarth has been appointed to the instructorship in mechanical engineering in the Lehigh University.

The Engineers' Club, of Philadelphia, is now located in its new quarters at 1317 Spruce street, Philadelphia, Penn.

J. L. Osgood, Buffalo, N. Y., has returned from a two months' trip in Europe which he took in the interest of his patented indestructible file and tool holders.

R. C. Lewis, manager of the Birmingham, Ala., office of Manning, Maxwell & Moore, has returned to Hartford and will look after the Connecticut territory for his company.

C. A. Hervey, formerly foreman of the E. S. Crane Machine and Tool Company, Cleveland, Ohio, has accepted the position as general foreman of the Olds Gas Power Company.

Charles Langlotz has recently accepted the position of mechanical superintendent of the Brooklyn Cooperage Company. Mr. Langlotz was formerly connected with a western railroad organization.

Ralph McCarthy, formerly general manager of the Stoever Foundry and Manufacturing Company, is no longer actively connected with this company. Mr. McCarthy has not as yet made any plans for the future.

C. J. Larson, who was connected with the Allis-Chalmers organization as district superintendent in the New York territory, has recently become chief engineer of the Union Electric Railway Company, Dubuque, Iowa.

F. E. Weston, superintendent of the Excelsior Needle Company, has been made general superintendent of that company, the Standard Company and the Progressive Manufacturing Company, with C. F. Newton as assistant at the Standard and Progressive works.

*Items for this column are solicited.

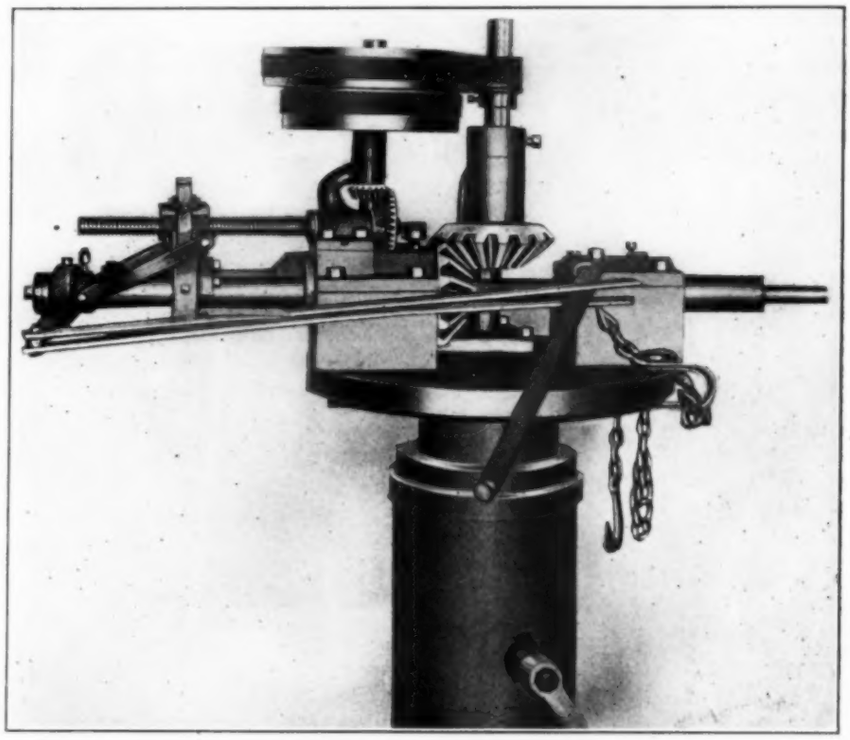
A Special Drilling Machine

By Ethan Viall

The drilling machine shown was used by a firm building street-car trucks, and was the only one of the kind built. The machine was intended to drill holes in the side irons of the mounted trucks only, and as a consequence its range of adjustment is limited. It can be raised or lowered slightly by means of a crank at the bottom and swung around in a circle, but that is about all. The car trucks were run alongside the drill on a special track and the chains were used to tie the truck and drilling machine together, so that the drill could bite properly, without danger of the truck springing away.

The drilling machine was run by a bevel gear connecting by its shaft with a special countershaft.

The machine, though roughly built, answered the purpose for which it was made and, as the cut shows, either hand or power feed could be used.



A SPECIAL DRILLING MACHINE

The American Locomotive Company has placed an order with the Niles-Bement-Pond Company for machine tools amounting to $230,000. Among other orders recently received by the Niles-Bement-Pond Company are the following: The entire machine-tool equipment for the new shops of the Idaho & Washington Northern railroad at Spirit Lake, Idaho, amounting to $30,000; St. Louis, Brownsville & Mexico railroad for $20,000 worth of machine tools; American Sugar Refining Company for electrical hoists aggregating $25,000 in value.

A Vertical Milling Machine with Vernier Scales

By A. J. Doughty*

We have found the most convenient way for the tool-making department is to have all dimensions given from two center lines running at right angles to one another, so that when a die block has been clamped to the platen at the correct angle, which in the case illustrated is 20 degrees, sired positions are obtained by setting the scale to the dimension on the blueprint, thus eliminating any possible chance for error by addition or subtraction, as would be necessary with the dimensions given in any other way. (See the halftone showing the scales on the miller.)

To further simplify in selecting the proper dimensions for any given hole, we give the two right-angle dimensions for each radius. For example, take the 15/32-inch hole which is 2 in Fig. 2, the workman moves the platen so the scale reads

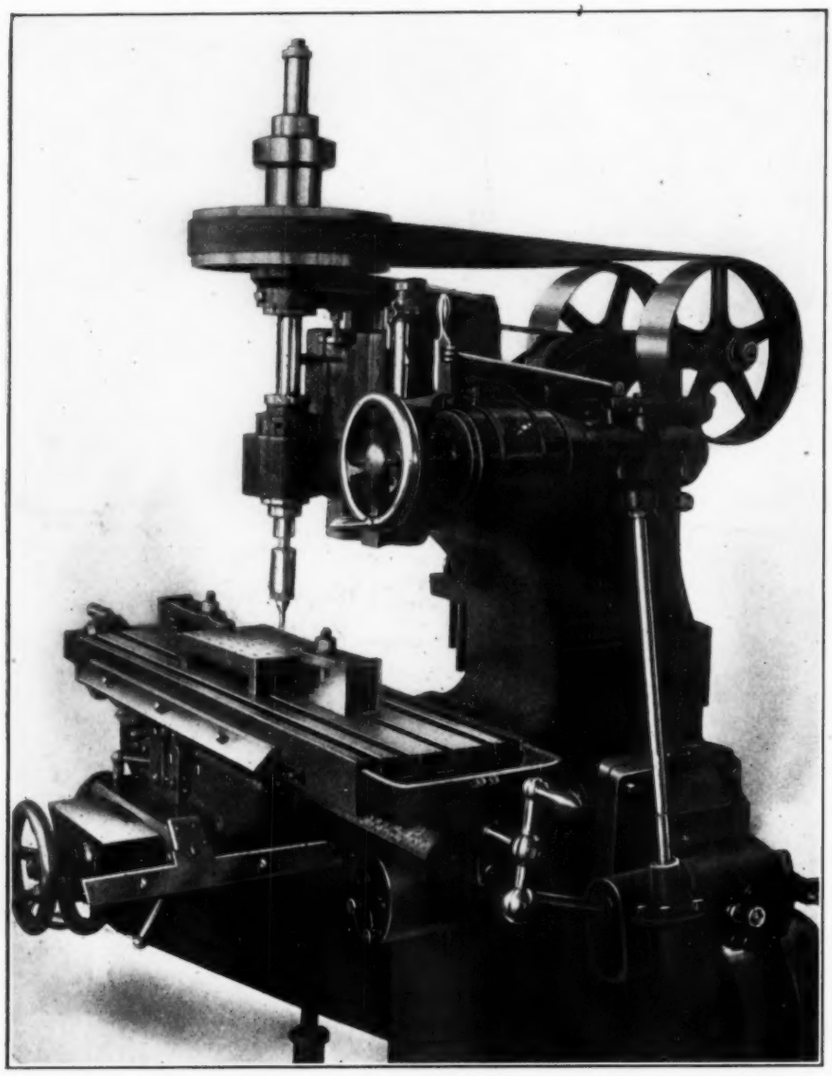


FIG. 1. A VERTICAL MILLING MACHINE WITH VERNIER SCALES FOR TOOL MAKING

one will run parallel to the platen and the other at right angles to it, or parallel to the cross travel. With the dimension so arranged the workman brings the position of any hole under the center of the spindle of the vertical milling machine and adjusts the Vernier scales to read the correct dimension for the selected hole. After the scales are once set they are not moved until the next job is started. With this method it is readily seen that all dimensions to locate them as close to the witness line as possible.

0.465 inch; he then follows down the center line of the hole until he finds dimension 2 and sets the cross scale to this dimension, which is 0.795 inch. This may seem to a great many like a lot of extra work for the draftsman, but we have found in practice that it pays, as the workman does not have to trace down a lot of long lines which are more or less confusing. We make it a point in giving

Fig. 2 of a progressive die for part 415-C shows the dimensions for laying out and boring holes and arcs on the vertical milling machine by this method.

*Factory manager, Burroughs Adding Machine Company.

Some Features of the German Patent Laws

By Henry E. Schmidt

In the following paragraphs are some general facts relating to German patent and trade-mark legislation and practice.

In Germany patent or trade-mark protection is granted to the first person (or firm or corporation) who applies for such protection. It is not necessary that he be the first inventor or originator or user of the invention or trade mark. But if the actual inventor *A*, of a patentable improvement can prove that the applicant *B*, has without the inventor's consent taken away from him and wilfully appropriated to himself the invention, he (*A*) can successfully oppose the grant of a patent to *B*; in that event *A* will obtain the patent. But *B* can successfully forestall this possibility by communicating the invention to any third party *C*, and letting *C* apply in his own name, in which case *A* will very seldom be in a position to prove that *C* is not entitled to the patent. Consequently *C* will obtain the patent and can then transfer or assign it to *B*.

An invention is patentable in Germany if it is new, that is to say, if it has neither been publicly used *in Germany* prior to the date of filing the patent application, nor been described in public prints of the last 100 years *in any country* prior to that date.

Foreign printed patent specifications which have issued before the date of filing in Germany are, under the German law, anticipations and will act to bar the obtaining of a valid German patent. The same rule applies as regards descriptive printed circulars, advertisements, etc. Thus, even the applicant's own United States patent or his own circulars, advertisements, etc., if issued prior to the date of filing his German application, will prevent his obtaining a valid German patent.

Of course, he can circumvent this by filing his German application under the benefits of the International Convention in which event his own prior United States patent will not act as a bar, provided that he file his German application within one year from the date of filing his United States application. In this connection it should be borne in mind, however, that as a rule the benefits of the International Convention can only be claimed by the person in whose name the prior United States application was filed; not by his assignee, except where the United States patent was assigned prior to the filing of the application in Germany.

In order to enable an assignee—or any other person than the original United States applicant—to claim the benefits of the International Convention in Germany on the basis of a prior United States application it will be necessary to produce documentary evidence showing that the original United States applicant has, already prior to the filing in Germany, actually transferred to such assignee—or other person—the right to file the German application in his own name and to claim suitable steps accordingly for preventing unscrupulous German firms from appropriating to themselves—as some of them will persist in doing to the detriment of honest business—the hard-earned fruits of their own skill and labor. To this end they should in every case where they have brought out an improved machine, tool or device worth protecting by patent or otherwise, apply for either patent or *"Gebrauchsmuster"* (utility model) protection in Germany. And they should do

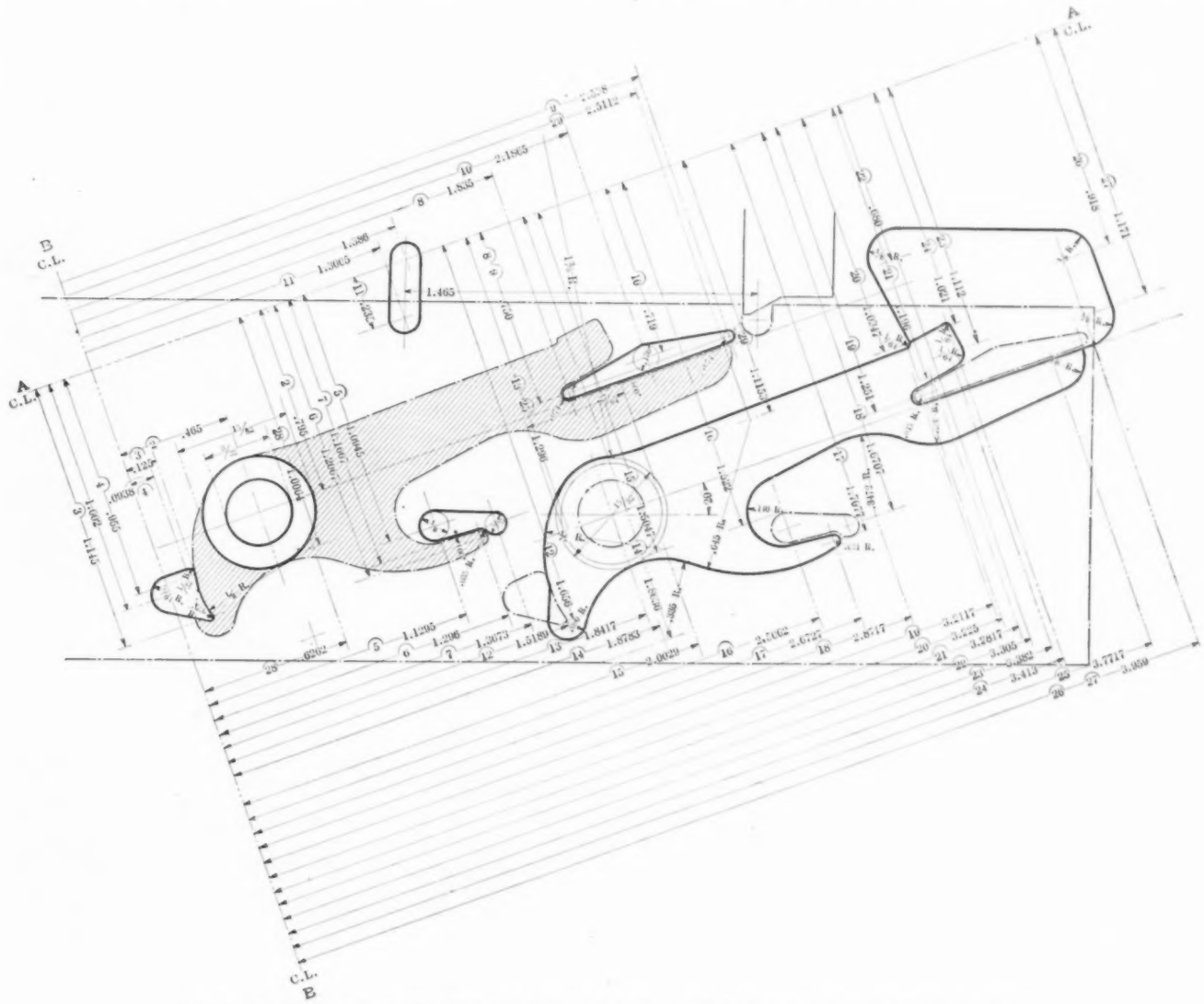


FIG. 2. DRAWING OF A BLANKING AND SHAVING DIE TO BE MADE IN A VERTICAL MILLING MACHINE

for such German application the benefits of the International Convention in respect of the assignor's prior United States application.

The benefits of the International Convention can be claimed in any stage of the proceedings before the German Patent Office, even after the final granting of the German patent. In that case a certified copy of the United States patent must be lodged with the German Patent Office.

American manufacturers, who wish to do a successful business with their products in Germany should carefully consider the above points and should take this both in proper time and in the proper manner.

In the first place, the German application should be filed before any descriptive printed matter (circular, price list, newspaper article, advertisement) is published anywhere, and before the United States patent issues, also before the invention (machine, tool or other article) is sold to, or exhibited in, Germany. Otherwise, any person who can show that the invention has thus become public before the date of filing the German application can successfully oppose the grant of the German patent, or obtain its annulment even after granting, except when the invention was exhibited at a national or State exhibition.

On the other hand, *mere public use outside of Germany* does *not* destroy the patentable novelty as regards Germany.

Gebrauchsmuster

Simpler inventions, or such in regard to which it appears doubtful whether they possess in themselves sufficient inventive merit to render the granting of a patent in Germany likely, may generally be protected by *"Gebrauchsmuster"* (utility model patent.) This sort of protection is granted without any previous official examination as to the merit of the invention or its novelty and is very cheap. The term of protection of a *"Gebrauchsmuster"* is only six years altogether, as against 15 years in the case of patents. The conditions as to validity are the same as in the case of patents.

In very important cases it may be advisable to apply both for patent and *"Gebrauchsmuster"* at the same time, so as to have at least the *"Gebrauchsmuster"* to

rely on in the event that a patent proper should not be obtained.

A manuscript or typewritten copy of the United States patent specification and copy of the drawings will be sufficient to enable a German patent attorney to prepare the documents for German patent and *"Gebrauchsmuster"* applications.

Trade Marks

Trade marks should also be applied for in Germany immediately on securing registration in the United States, because according to the German law the first applicant can obtain registration of any trade mark, no matter whether he be the first user or whether others have used it years before him. In fact, it is not an infrequent occurrence for German firms to obtain registration of design or word trade marks which have been originated and used for some time by others, and then successfully oppose the proprietors' application for registration of their own trade-mark law in this respect has for further use of the same in Germany.

The deficiency of the present German trade-mark law in this respect has for some time been recognized on all sides and strenuous endeavors are being made to change it, but so far this has not yet been done.

Individuals, firms or corporations not having any business domicile (branch office) in Germany can only obtain registration in Germany in respect to such trade marks as are registered for them in their home country. Thus, Americans applying for registration in Germany must to that end obtain from the United States patent office a certified copy of their United States trade-mark registration. The applicant must also sign a power-of-attorney. Blanks of such powers will be furnished on demand.

[Mr. Schmidt refers to the International Convention; in reply to our request Dr. Alfred Muller has contributed a brief article setting forth some of the features determined by that convention.—Ed.]

Provisions of the Agreement of the International Convention

This international convention referred to in this article and to which the United States adhered May 30, 1887, was concluded at Paris, March 20, 1883, for the protection of industrial property, and "to contribute to the guarantee of the right of inventors." The original agreement between the contracting countries was amended by the Brussels act of December 14, 1900.

The more important features determined by the convention are:

First—The subjects or citizens of one country shall enjoy in all the other countries of the Union all the advantages with respect to protection for their inventions, designs, industrial marks and trade marks, which are accorded to subjects or citizens of those countries.

Second—Provided an application for patent is filed within 12 months of the date of the first application elsewhere, a valid patent will be granted in those countries being parties to the international convention, though the invention may have been published prior to the filing of the application and notwithstanding its working (exploitation) in the country in which the patent is sought.

Third—Patents obtained in the different contracting countries shall be independent of patents obtained for the same invention in the other countries, whether adherent to the Union or not.

Fourth—The introduction by the patentee into the country where the patent has been granted, of articles manufactured in one or other of the States of the Union shall not entail forfeiture, but the patentee remains subject to the obligation to work his patent in conformity with the lands of the country in which he obtained the patent.

Following is a list of the countries now adhering to the convention:

Belgium, Denmark, France, Germany, Great Britain, Switzerland, Mexico, Brazil, Ceylon, Japan, Italy, Norway, Portugal, Spain, Sweden, Australia, New Zealand, Tunis, Cuba, Trinidad and Tobago and the United States.

While Canada is not a member of the convention it is more liberal than most other countries, as a valid patent can be obtained in Canada if application is filed within one year from the date of the first patent obtained elsewhere.

Local Metal Trades Meeting

The Fitchburg and Worcester members of the Metal Trades Association got together on July 9 at Whalom Park for the afternoon and evening and had a very enjoyable time. The ball game was umpired by E. E. Bartlett, of Boston, whose startling decisions were impartially distributed. The program included a sail on the lake, bowling, lunching, and the open-air theater in the evening, where many hits were made on Worcester members. It is the general belief that such informal outings bring manufacturers in closer personal touch than can be done in any other way.

Business Items

Cutler-Hammer Manufacturing Company, Milwaukee, has appointed Otis & Squires, 111 New Montgomery street, San Francisco, representatives for the Pacific Coast.

Owing to the increased call upon it for completely finished valve stems and other similar work the Electric Welding Products Company, Cleveland, Ohio, has recently installed a grinding and finishing department.

In order to more truly indicate the nature and scope of its business The Electric Controller and Supply Company, of Cleveland, Ohio, has changed its name to The Electric Controller and Manufacturing Company.

The L. S. Starrett Company, Athol, Mass., has opened a warehouse at 36-37 Upper Thames street, London, E. C., and will carry its tools, hack saws, steel tapes, etc., in stock at that place. E. P. Barrus will be in charge.

Trade Catalogs

Pratt & Whitney Company, Hartford, Conn. Catalog describing spline milling machine. Illustrated, 22 pages, 9x12 inches, paper.

The Bristol Company, Waterbury, Conn. Bulletin No. 92, illustrating and describing recording thermometers, Class II. 12 pages, 8x10½ inches.

Baldwin Locomotive Works, Philadelphia, Penn. Record No. 65, describing mallet articulated compound locomotives. Illustrated, 46 pages, 6x9 inches, paper.

D. R. Wood and Company, 400 Chestnut street, Philadelphia, Penn. Catalog of hydraulic tools, crane and machinery. Illustrated, 122 pages, 8½x10 inches, paper.

Gisholt Machine Company, Madison, Wis. Booklet of Gisholt tools, including turret lathes, boring mills, tool grinders, drilling machines, etc. Illustrated, 72 pages, 3½x6 inches, paper.

J. W. Paxson Company, Philadelphia, Penn. Bulletin No. 18, describing molding sand, core sand, fluxing, linings, core-making machines, sand-blast machines, etc. Illustrated, 132 pages, 6x9 inches, paper.

Whiting Foundry and Equipment Company, Harvey, Ill. Booklet entitled "The Foundrymen's Reference Book," especially designed for distribution at the Toronto Foundrymen's Convention. Illustrated, 32 pages, 6x9 inches, paper.

Business Opportunities

The Bailey Lumber Company, Virginia, Minn., will erect a new mill.

The Carter Motor Car Company, Hyattsville, Md., is enlarging its plant.

J. H. Smallings, Johnson City, Tenn., will establish a canning plant.

The Dayton (Ohio) Lumber and Manufacturing Company will erect a new plant.

A new $10,000 power plant is to be installed at the University of Colorado at Boulder.

A new machine shop is being built for the Consolidated Elevator Company, Duluth, Minn.

It is announced that the A. M. Byers Company, of Pittsburg, will build a new steel plant at Girard

The Jackson & Corbett Bridge and Steel Company, Chicago, Ill., will build an addition to bridge works.

The Portland (Ore.) Railway, Light and Power Company has taken out a permit for a sub-power station.

William Haws & Sons, operating the Cairo (Ill.) Handle Factory, will establish a branch plant at Dyersburg, Tenn.

The Automatic Wagon Brake Company, of Lincoln, Neb., is contemplating the erection of a new foundry at Council Bluffs, Iowa.

The New York Central Railroad is planning to begin work on the new erecting shop at West Albany, which will cost over $200,000.

The Wessinger Manufacturing Company, Duluth, Minn., making steam specialties, will build an addition and install new machinery.

The Howard Stove and Manufacturing Com-

pany, of Savannah, Mo., will move to Ralston, Neb., where a new plant will be erected.

A plant is being erected for the E. S. Brace Company, Niagara Falls, for the manufacture of a patent brace for holding bits and tools.

The Canace Manufacturing Company, Centralia, Mo., will establish a plant in El Reno, Okla., to manufacture electrical appliances.

The B. H. Pugh Manufacturing Company, Topeka, Kan., making a complete line of potato machinery, will erect a new up-to-date plant.

It is reported that the Fuller Combing Gin Company, of Charlotte, N. C., is arranging to build a $200,000 plant at Chattanooga, Tenn.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids on the following dates: July 21, leather belting (schedule 72), traveling crane (schedule 54), mast crane (schedule 74), electrical supplies (schedule 69, 70), hydraulic jacks (schedule 74), circular saw (schedule 74), brass tubing (schedule 73), hack-saw blades, dies, drills, files (schedule 71). August 4th, auxiliary hoist for electric crane (schedule 78), induction motor (schedule 79).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Wanted—One old style No. 13 B. & S. milling machine. First-class condition not absolutely necessary. Box 234, AMER. MACHINIST.

Wanted—Machinery or machine parts to build by contract. Ideas developed; drawings made. Address "A," care AMER. MACH.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted—By a firm of English engineers a good reliable firm to negotiate the sale of an important patent in the United States. Apply Box 283, AMERICAN MACHINIST, 6, Bouverie Street, London.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris streets, New York City.

Wanted—A good working partner with small capital can secure interest in a well equipped machine plant, established over 20 years, located on line of P. R. R. and P. & R. railroads, between New York and Philadelphia. Write for particulars. "W.," AMERICAN MACHINIST.

New Patents Act—A firm of engineers and merchants having warehouses and offices in London, Birmingham, Glasgow and Manchester is prepared to take up selling agencies for machines and small tools. Apply "X. Y. Z.," care AMERICAN MACHINIST, 6, Bouverie Street, London, England.

A small shop, well located, 16 miles from New York, with work in hand beyond its capacity, would take as active partner a thoroughly practical man with some capital. Automobile specialties. Good contracts. No attention paid to any but strictly bona fide answers from responsible parties. Box 284, AMER. MACH.

If there is a machine builder who is equipped with up-to-date plant and capital to build an automatic multiple screw machine he can make a satisfactory deal with owner to do so. Machine can be seen in operation, is thoroughly advertised and has many advantages over the other machines in the market.
Box 297, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Superintendency by energetic experienced mechanic up on handling help, factory costs, organization and production. Box 288, AMERICAN MACHINIST.

ILLINOIS

Designer with experience on special machinery for manufacturing machine tools, presses and dies. Box 287, AMERICAN MACHINIST.

An experienced designer of tools and special machinery, with experience in charge of tool room. Technical and reliable. Box 279, AM. M.

Up-to-date tool room foreman desires change; experienced on design and construction of sub-press dies, and tools for manufacturing adding machines, cash registers and small arms. Age 30. Married. References furnished. Box 241, AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman wishes position. Address Box 280, care AMERICAN MACHINIST.

An accomplished draftsman desires change. Executive ability. Box 289, AMERICAN MACH.

Up to date machine shop foreman desires position, can give reference as to ability. Box 298, AMERICAN MACHINIST.

Mechanical engineer; specialty, condensing apparatus, pumping machinery, etc., open for engagement. Box 274, AMERICAN MACHINIST.

NEW YORK

Stenographer, hard worker, experienced engineering office, wants position. $16-$20. "L. D.," AMERICAN MACHINIST.

Technical graduate, 32; seven years' experience in shop, six years in drafting room. First class machine designer, accurate, rapid, hard worker. Box 294, AMERICAN MACHINIST.

Experienced and thoroughly practical shop man who is also a competent draftsman and designer, up to date in modern shop practice; desires responsible position. Box 277, AM. MACH.

Thirty-five hundred dollar man wants an opening. Can hold down any position man of that price should be capable of filling in mechanical manufacturing line. Worked up from apprentice to assistant superintendent with one concern, working through all the departments. Capable of handling 5,000 men. Executive ability and personality marked. Box 291, AMERICAN MACHINIST.

PENNSYLVANIA

Educated machinist, 27, desires office or road position. Frederick Huber, Downington, Pa.

A first-class toolmaker and machinist, up-to-date on high cutting speeds, wants work. Not particular as to location. Box 285, AM. MACH.

WEST OF MISSISSIPPI

Technical graduate with nine years' experience in gasolene motors and motor cars wants position as assistant to superintendent. Box 295 AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Exceptionally well qualified designer, capable of originating complete line of rotary and jaw shears, punches, bending rolls, flangers, riveters, and auxiliary equipment used in boiler and structural shops. State education, experience, age and expectations first letter. Mere job hunters need not apply. Box 292, AM. MACH.

INDIANA

Wanted—Five (5) first-class toolmakers. Box 255, AMERICAN MACHINIST.

MASSACHUSETTS

Production man for company manufacturing monkey wrenches and a line of special wrenches. Man preferred who has a successful record on this kind of work. Good opportunity for man who can produce results with piece work. Box 257, AMERICAN MACHINIST.

Wanted—As shop superintendent or general foreman, a man who has a successful record in manufacturing monkey wrenches and similar work, Forge and foundry experience is not absolutely necessary. Plant is new and modern and is now running day and night. Do not apply unless thoroughly competent to take charge of 100 men and make good in quantity, price and quality of output. Give outline of record, references and mention salary desired. Box 286, care AMERICAN MACHINIST.

NEW JERSEY

Wanted—Foreman thoroughly familiar with sheet metal and press work. Must have good executive ability. State fully experience and references, also wages expected. Box 293, AMERICAN MACHINIST.

Wanted—Assistant general foreman for a printing press factory in New Jersey. Only competent, hustling, reliable men need apply. State references, age and salary expected. Box 296, AMERICAN MACHINIST.

NEW YORK

Wanted—Several first-class toolmakers; bench hands preferred; state experience, wages expected, married or single and age. Box 147, Elmira, N. Y.

Wanted—A resourceful, experienced man to superintend a large established metal drawing, stamping and finishing plant. Must be able to handle men and know how to obtain results. Address "Drawn Work," AMERICAN MACHINIST.

Wanted—Young engineer and draftsman with practical and theoretical knowledge of refrigeration, hydraulics, etc. Must travel considerably. State qualifications, age, references, salary expected to start on and how soon available. Address "Special Field Work," AMERICAN MACHINIST.

Wanted—A skilled and experienced machine designer about 28 to 32 years of age for a teaching position in a technical school in the East. Pleasing and forceful personality and enthusiasm required. Entering salary about $1500.00. Apply, stating age, education, practical experience and any other qualifications in detail, to "X," AMERICAN MACHINIST.

OHIO

Wanted—Superintendent and designer of screw machines and turret machinery. Box 217, AMERICAN MACHINIST.

Wanted—Screw machine hands for Cleveland automatic, Potter & Johnston and Warner & Swasey hand screw machines. State experience, wages and when available. Address, The International Harvester Company, Akron, Ohio.

PENNSYLVANIA

Foreman for erecting heavy machine tools; must be experienced on accurate machine tool work, with ability to increase production and efficiency; state age, experience and salary expected. Box 278, AMERICAN MACHINIST.

For Sale

For Sale—Foundry, machine and carpentry shops, with government concession for twenty years, at Hermosillo, Mex. Box 281, AM. MACH

For Sale or Rent—Foundry, machine and woodworking shop, also blacksmith shop, in fine village of 5000, with use of machinery. Fine opening for a good business. Box 227, Bergen, N. Y.

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